EMHSD Publication 106 (April 2024)
Emergency Management Homeland Security Division
Michigan Department of State Police

Michigan Hazard Mitigation Plan

Prepared by the:
Emergency Management and Homeland Security Division
Michigan Department of State Police

In conjunction with the:
Michigan Citizen-Community Emergency Response Coordinating Council

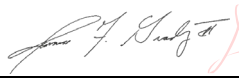
STATEMENTS OF ADOPTION

Michigan Hazard Mitigation Plan

This plan has been developed and approved by the Michigan Department of State Police Emergency Management and Homeland Security Division (MSP/EMHSD) and the Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) in accordance with Michigan law under 1976 PA 390 (as amended) and the federal Disaster Mitigation Act of 2000 (PL 106-390), 44 CFR §201.4. The departments and agencies of this state will work in conjunction with the MSP/EMHSD and MCCERCC in order to implement the goals and objectives contained in this plan. As required under 44 CFR §201.4(c)(7), the state assures that it will comply with all applicable federal statutes and regulations in effect with respect to the periods for which it receives grant funding, amending this plan whenever necessary to reflect changes in state or federal statutes and regulations.

Dated 03/17/2024

Capt. Kevin Sweeney, Deputy State Director of Emergency Management, and Commander of the Emergency Management and Homeland Security Division, Michigan State Police

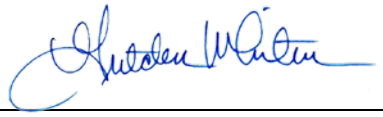


Dated

Col. James F. Grady II, Director of the Michigan Department of State Police, State Director of Emergency Management, and Michigan's Homeland Security Advisory

Michigan Hazard Mitigation Plan

This plan, having been approved by the State Director of Emergency Management (Colonel James F. Grady II) and the Deputy State Director of Emergency Management (Captain Kevin Sweeney), is hereby formally adopted by the State of Michigan in accordance with the federal Disaster Mitigation Act of 2000 (PL106-390), 44 CFR §201.4(c)(6).



Dated April 2, 2024

Gretchen Whitmer, Governor

Michigan Hazard Mitigation Plan (2024-2029 Edition)

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Chapter 1: Introduction

Plan Purpose

Content within the Michigan Hazard Mitigation Plan (MHMP) provides a framework and foundation for state hazard mitigation activities necessary and in accordance with Public Law 93-288 (Robert T. Stafford Disaster Relief and Emergency Assistance Act, as amended by the Disaster Mitigation Act of 2000). The MHMP serves as the state hazard mitigation plan required under Section 322 that is a condition for receiving certain types of grants and federal disaster relief assistance.

The Michigan State Police, Emergency Management and Homeland Security Division (MSP/EMHSD) is responsible for publishing this plan based upon federal law and policy guidance provided by the Federal Emergency Management Agency (FEMA). This plan was officially accepted and approved by FEMA in April 2024 and is valid for a five-year period that ends in April 2029.

Hazard Mitigation

Hazard mitigation is accomplished through the coordination of available resources, programs, initiatives, and authorities at the state, federal, and local levels, including through partnership with private organizations and the general public. For purposes of this plan, hazard mitigation is any action taken before, during, or after a disaster or emergency in an effort to permanently reduce or eliminate the long-term risk to human life and property from emergency management related hazards. As used in this context, risk is generally best described as the potential for damage or loss from interaction with these hazards.

With successful mitigation, the impacts of imminent hazards will be less damaging than would have otherwise been experienced, potentially not escalating into emergencies or disasters. Some specific risks may be able to be removed entirely. Hazard mitigation reduces the impact of hazards onto people and property, as well ameliorating and setting the stage for the recovery of affected environmental and economic conditions.

Plan Scope

Emergency management related hazards can be of a natural, technological, or human-related nature. Historically, requirements for FEMA hazard mitigation plans have centered on those natural hazards (e.g., flooding, tornadoes) that have actually caused or could potentially create disastrous or emergency conditions within the state. State, federal, and local disaster declarations are frequently issued as a result of such incidents. Select technological hazards (e.g., chemical spills, power outages) and human-related hazards (e.g., terrorism, pandemics) are also contemplated as part of the MHMP. The plan and its core aspects:

- Summarize the analysis of these hazards as they have impacted the state, or have the potential to impact the state, as included in the Michigan Hazard Analysis (MHA).
- Contemplate future changes within the state as they relate to these hazards, including as modified by climate, populations, and land use.
- Provide an overview for the vulnerability of Michigan counties, as well as analyzing critical infrastructure and key resources throughout the state (including also for state owned and operated facilities).
- Evaluate the state's mitigation programs, policies, and capabilities that are used to address the identified hazards.
- Establish goals and objectives intended to reduce the long term vulnerabilities from the identified hazards.

Specifically, as related to local government within Michigan, the MHMP also includes:

- Information on the status of local hazard mitigation plans within Michigan.
- The process used by MSP/EMHSD to coordinate with and support the development of approvable local government mitigation plans, including for their review and approval.
- A synopsis of the content included in local hazard mitigation plans.

Additionally, this plan includes materials to ensure compliance with FEMA's High Hazard Potential Dams (HHPD) Grant Program.

Plan Process

This 2024 edition of the MHMP represents a complete update to the state's last fully updated hazard mitigation plan (Pub. 106, 2019). Please see Appendix 1 for a detailed description of the planning process, including key stakeholders, timelines, and methods.

Legal Authorities, Requirements, and Assurances

The MHMP is developed under the authority of 1976 PA 390, the Michigan Emergency Management Act, as amended. This Act and its subsequent administrative rules provide MSP/EMHSD with broad authority to carry out the emergency management activities of mitigation, preparedness, response, and recovery within the state of Michigan. The Act also empowers each state department to carry out emergency tasks as assigned in the Michigan Emergency Management Plan (MEMP) or via other methods (such as the development and implementation of hazard mitigation measures).

The State Mitigation Planning Policy Guide (FP 202-094-2, April, 2022) provides official guidance from FEMA for the development of this plan. The MHMP contains additional materials intended to go beyond federal requirements in order to qualify for accreditation by the Emergency Management Accreditation Program (EMAP).

As evidenced by the official statements of adoption available at the beginning of this publication, the State of Michigan will manage and administer FEMA funding in accordance with applicable federal statutes and regulations. These assurances include, but are not limited to, compliance with the:

- Code of Federal Regulations, as it relates to uniform administrative requirements, cost principles, and audit requirements for federal awards (2 CFR Part 200).
- Robert T. Stafford Disaster Relief and Emergency Assistance Act, Public Law 93-288, as amended (42 USC § 5133).
- The Hazard Mitigation Assistance Program and Policy Guide.
- Hazard Mitigation Assistance Guidance.

Note on Departmental Name Changes

References to governmental agencies within the MHMP are presented as those agencies were named when the plan was being finalized in early 2024. Where such names have subsequently been changed, please interpret the names in this document as applying to the newly named agencies. Historical references to former agencies may be left unchanged in this document where they occur within the context of a quotation, summary, or record of previous plans and documents.

Public Comment

The primary MSP/EMHSD webpage includes many useful links, including contact information. This can be accessed at michigan.gov/msp/divisions/emhsd. Email may also be sent to MSP-MHMP-HazardFeedback@Michigan.gov for those wishing to specifically comment on this or future editions of the plan.

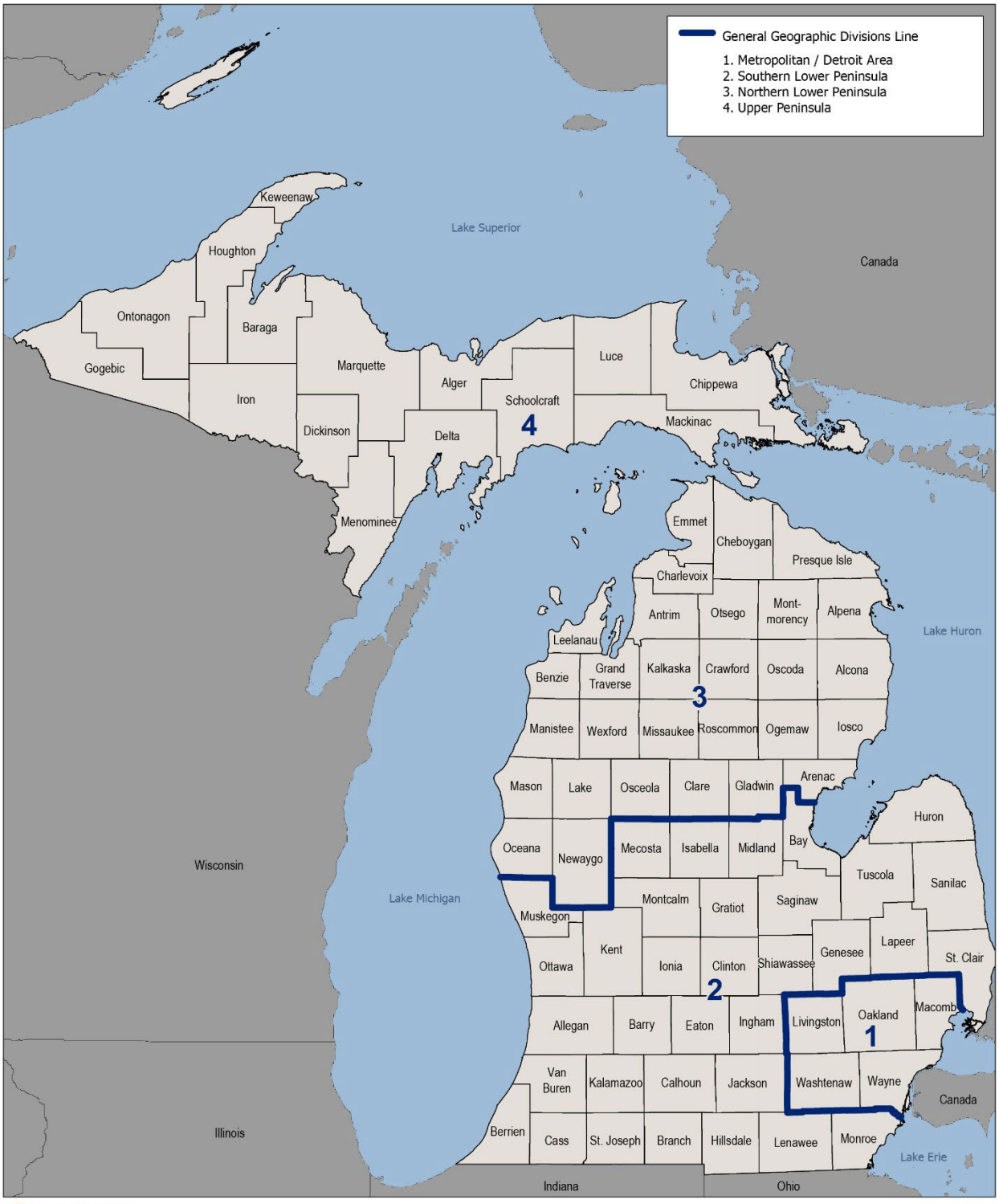
Postal service comments or inquiry may be mailed to the Michigan Department of State Police, Emergency Management and Homeland Security Division, Attn: State and Local Planning Unit, P.O. Box 30634, Lansing, Michigan, 48909.

Chapter 2: State Profile

Located in the Upper Midwest of the continental United States, Michigan has a land area of 58,216 square miles and a population of roughly 10 million people (US Census, July 2022). Its 83 counties have been grouped below into four geographic divisions. These areas don't mirror official MSP/EMHSD regions and are only used for generalized analysis.

Division 1: Metropolitan / Detroit (5 counties)
Division 2: Southern Lower Peninsula (34 counties)
Division 3: Northern Lower Peninsula (29 counties)
Division 4: Upper Peninsula (15 counties)

State of Michigan (As Divided into Four General Geographic Divisions)



Michigan State Police
Emergency Management and
Homeland Security Division

Date: 6/21/2023

County placement is listed below, in an order that follows a geographic orientation that generally begins with a division's most southwest county and then continues east, moving across in rows and eventually ending to the north and east. This format is currently being retained for consistency with past editions of this publication.

County Placement Within Four General Geographic Divisions

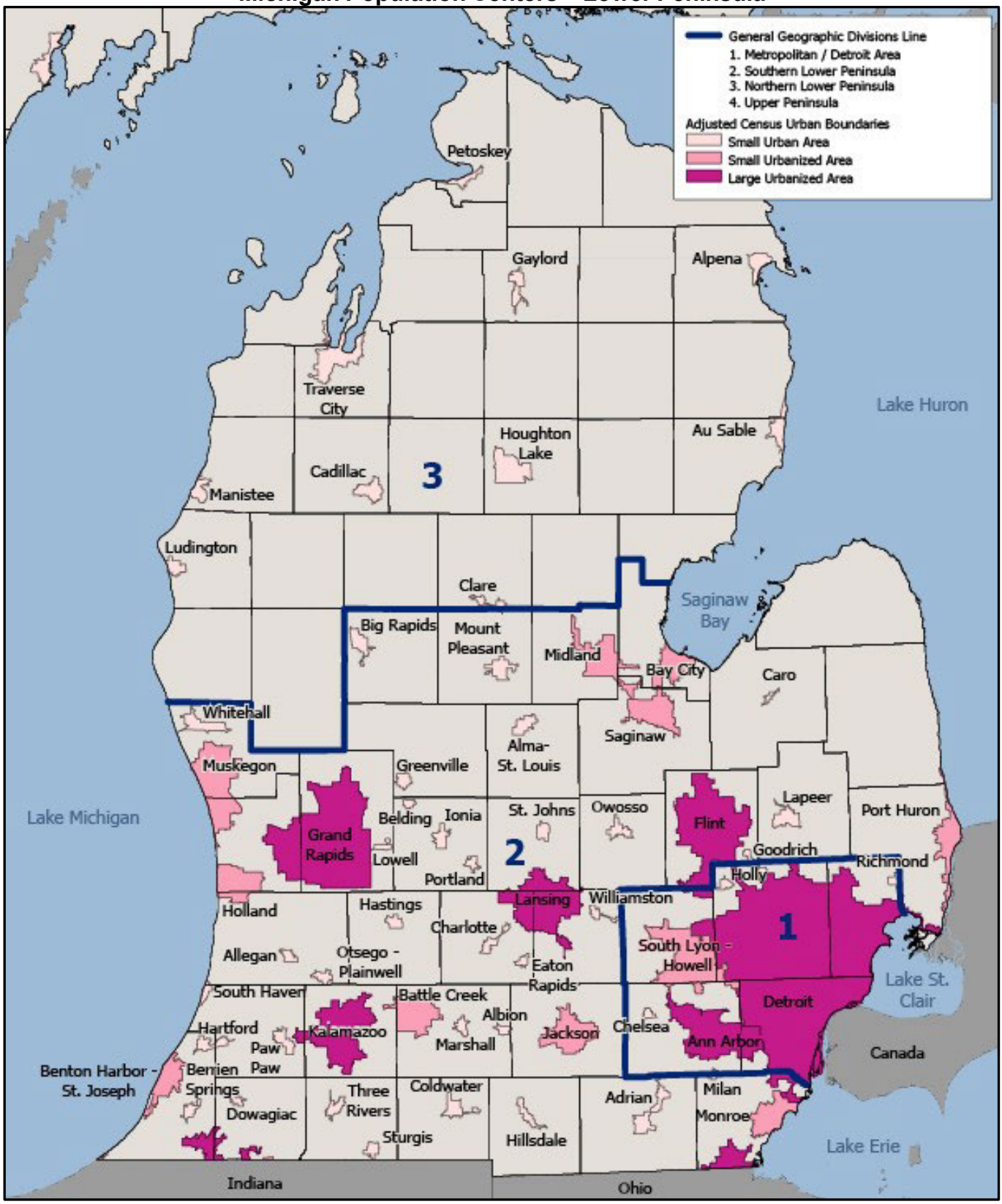
Metropolitan / Detroit	Southern Lower Peninsula	Northern Lower Peninsula
Washtenaw	Berrien	Oceana
Wayne	Cass	Newaygo
Livingston	St. Joseph	Mason
Oakland	Branch	Lake
Macomb	Hillsdale	Osceola
	Lenawee	Clare
Upper Peninsula	Monroe	Gladwin
Gogebic	Van Buren	Arenac
Iron	Kalamazoo	Manistee
Ontonagon	Calhoun	Wexford
Houghton	Jackson	Missaukee
Keweenaw	Allegan	Roscommon
Baraga	Barry	Ogemaw
Marquette	Eaton	Iosco
Dickinson	Ingham	Benzie
Menominee	Ottawa	Grand Traverse
Delta	Kent	Kalkaska
Schoolcraft	Ionia	Crawford
Alger	Clinton	Oscoda
Luce	Shiawassee	Alcona
Mackinac	Genesee	Leelanau
Chippewa	Lapeer	Antrim
	St. Clair	Otsego
	Muskegon	Montmorency
	Montcalm	Alpena
	Gratiot	Charlevoix
	Saginaw	Emmet
	Tuscola	Cheboygan
	Sanilac	Presque Isle
	Mecosta	
	Isabella	
	Midland	
	Bay	
	Huron	

Located in the midst of four Great Lakes, Michigan is divided by water into two peninsulas. It has the longest freshwater shoreline of any state (roughly 3,200 miles), several islands, and over 10,000 inland lakes. The Lower Peninsula contains approximately 70% of the state's total land area, with the Upper Peninsula comprising 30%. The southern half of the Lower Peninsula has a level to gently rolling surface, with hills rising to elevations between 1,000-1,200 feet, while its northern half has hilly belts reaching elevations of 1,200-1,700 feet. The eastern half of the Upper Peninsula is often swampy, with the western half containing a more rugged region that reaches almost 2,000 feet.

Michigan is well known for having the highest automobile production of any state. It has a diverse economy based on manufacturing, agriculture, tourism, services, and professional trades. Michigan is a leader in the machine tools, office furniture, chemicals, and plastics sectors, along with major advanced technology industries and university research hubs. The state is one of the nation's leading agricultural producers, consistently ranking number one in several product categories (including specialty crops such as cherries).

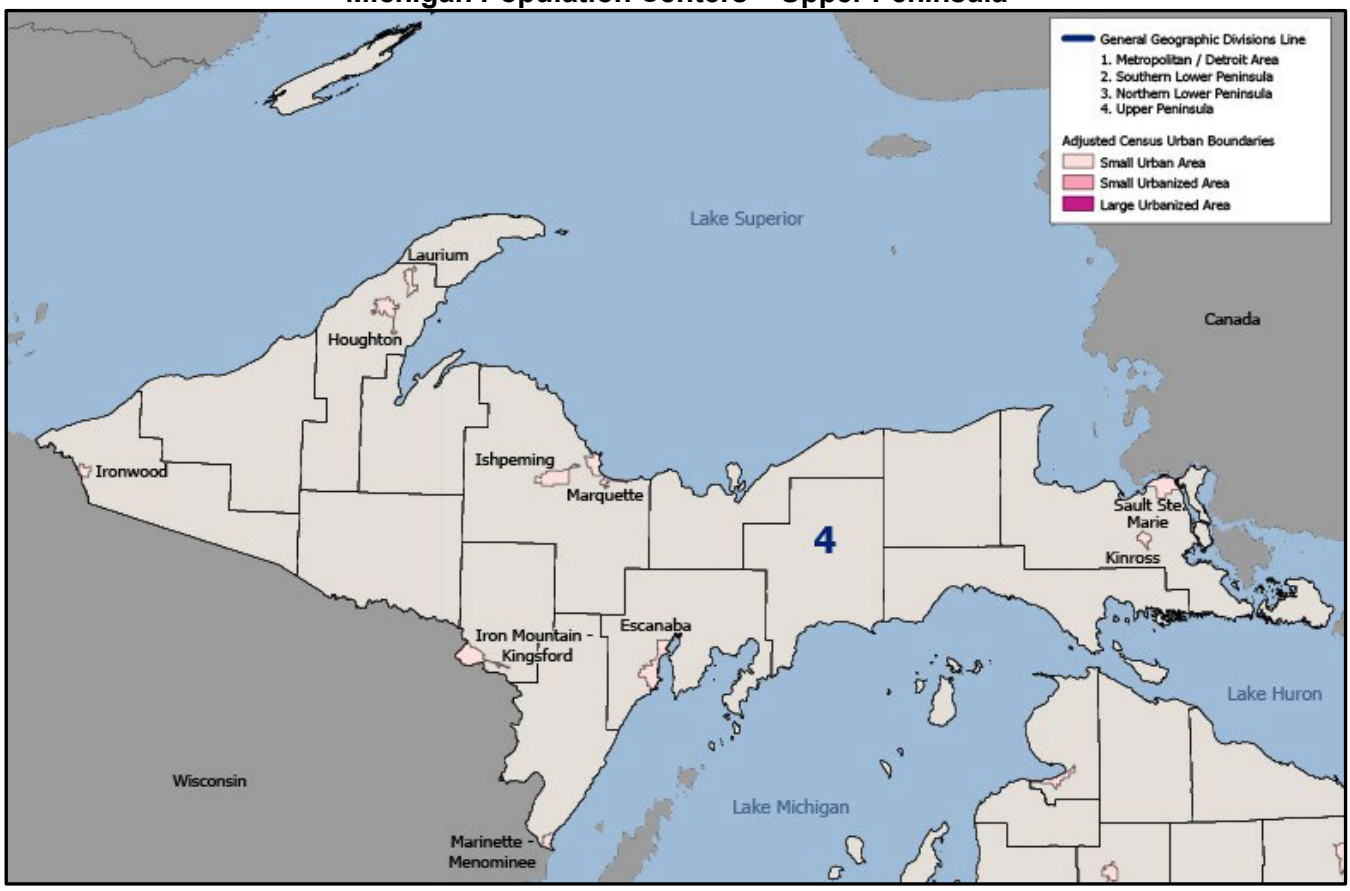
Michigan counties include local, incorporated government entities categorized as cities, townships, and villages. The state has several urbanized areas, most notably Metropolitan Detroit in Division 1. The majority of Michigan residents live in the 39 counties that are part of Divisions 1 and 2 (see map, next page).

Michigan Population Centers – Lower Peninsula



(source: MSP/EMHSD, June 2023; Adjusted Census Urban Boundaries include: urban cluster areas with minimum population of 5,000, or urbanized areas as designated by the U.S. Census, or entire corporate limits of any incorporated city or village designated as partially urban by the Census, or adjacent areas which meet other agreed upon specified criteria.)

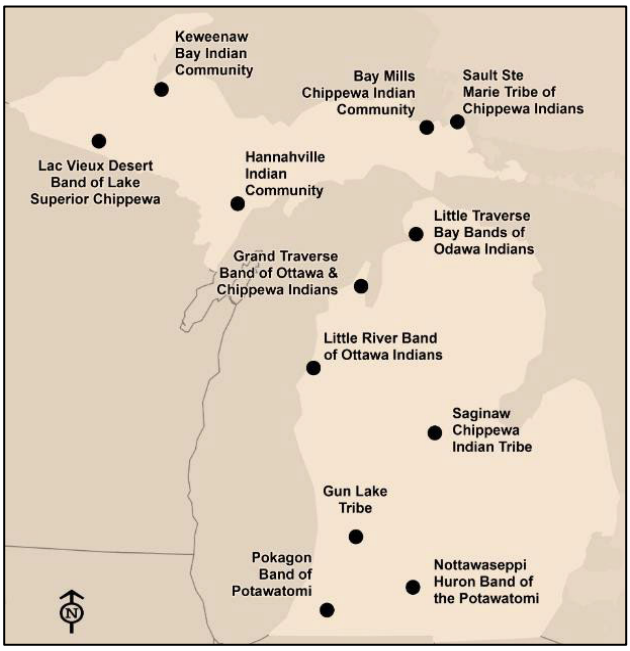
Michigan Population Centers – Upper Peninsula



(source: MSP/EMHSD, June 2023)

More detailed information related to population, demographics, and land development is found in Appendix 2. Michigan climate categories (Köppen) for Divisions 1 and 2 are generally assigned as Köppen Dfa. Divisions 3 and 4 are generally Köppen Dfb and are more heavily forested. Beyond Köppen, the United States Department of Agriculture (USDA) provides Plant Hardiness Zone maps. Primary state climate trend information is provided in Appendix 3.

Federally Recognized Tribes (Michigan)



(source: State of Michigan, April 2023)

Twelve federally recognized sovereign tribal nations are located within Michigan. The accompanying map is intended only for general purposes, with a more detailed map best viewed online due to the small size of some land parcels. Especially large tribal reservations are located within the geography of Isabella and Baraga Counties. Additional information on tribal governments can be found HERE.

Michigan and its counties also share land and water borders with several states as well as with Canada. Adjacent states are shown on the preceding maps, with water borders shown on the state's official transportation map. More information on these shared border areas can be found on the next page.

Other maps can be viewed on EMHSD's Online Tools webpage. These include the National Risk Index (NRI), the Resilience Analysis and Planning Tool (RAPT), and the MiEJScreen: Environmental Justice Screening Tool.

Michigan shares land and water borders, including via water borders within the Great Lakes, with Ohio, Indiana, and Wisconsin. Illinois and Minnesota also share official water borders with the state. Both of Michigan's peninsulas connect directly to Canada via bridges and tunnels. The border areas of these entities in general have similar hazards to those seen in Michigan.

Watershed movement and wind direction are important factors when considering border hazards. The Great Lakes are part of an immense watershed that is also impacted by ballast waters from international ships. Many Michigan communities draw their water supplies from the Great Lakes. Airborne pollution and smoke can reach critical levels due to industrial accidents and wildfires. The risk of outside species establishing themselves has also increased due to climate change. Some border considerations include:

Ohio

- The Toledo area has several major industrial clusters as well as petroleum pipelines crossing the border. The Kinder Morgan Utopia Pipeline and Buckeye Partners pipelines are some examples.
- The Davis-Besse nuclear plant has some parts of southeast Michigan within the edge of an Emergency Planning Zone. Typical wind and water flow directions tend to minimize concerns.
- The Maumee River contributes fertilizer runoff to western Lake Erie, leading in part to algal blooms.
- Roughly 150 Michigan residents live in the detached "lost peninsula", only accessible by land via Ohio.

Indiana

- Cities such as Gary, Burns Harbor, and others contain heavy industry. Hazardous materials releases could impact Michigan via air or water. A British Petroleum oil refinery in Whiting is the largest in the Midwest, and any interruptions to its operations may impact gasoline prices. A new Midwest Hydrogen Hub was announced in October 2023 that will include portions of these areas. A large electric vehicle battery plant near the Michigan border is expected to begin operations in 2026.

Wisconsin

- A heavily forested land border with the Upper Peninsula could see forest fires from Wisconsin spread into Michigan. Pipelines and nearby industries exist, such as a Johnson Controls facility in Marinette, Wisconsin.
- With an extensive shared Lake Michigan water border, along with generally westerly winds, some incidents originating in Wisconsin have the potential to impact Lower Peninsula shorelines and other areas depending on their nature and scope.

Canada

- Petroleum pipelines that rupture could impact Michigan waters/shorelines. Notable locations where pipelines are near or cross borders include in the Upper Peninsula as well as St. Clair County.
- Significant Canadian cities such as Windsor are separated from Michigan only by the Detroit or St. Clair Rivers. Some areas, such as Sarnia, are known for extensive industrial and chemical facilities.
- Freight frequently passes through from Canada via bridges and rail. Of note, the Michigan Central Railway Tunnel goes underneath the Detroit River.
- Some natural gas storage facilities within Michigan are fed by pipelines coming from Canada.
- Uranium processing in Blind River, Ontario is roughly 70 miles from Sault Ste. Marie. It supplies materials to the Bruce Power nuclear plant on the Canadian side of Lake Huron. The plant does not present significant radiological risks to Michigan.

Illinois and Minnesota

- Michigan shares water borders with both states. Significant waterborne shipping includes from Duluth, Minnesota, and Chicago, Illinois. While most shipping is not related to hazardous materials, spilled fuel is also possible.
- The threat of invasive carp primarily presents itself via waterways running through Illinois.

Beyond the scope of this chapter, regions that don't directly touch Michigan may still have their hazards impact the state in various ways. Examples include potential evacuees requiring shelter, as from a future potential "New Madrid" type earthquake. The interconnectedness of the electric grid and pipelines, while beneficial, does mean that far away energy incidents may still contribute to Michigan blackouts or energy shortages. Weather, air travel, cyberattacks, and a host of other potential hazards frequently develop from well outside of Michigan's borders, including internationally.

Chapter 3: State Assets, Jurisdictions, and Critical Infrastructure

Section 1: State Assets

As the state's primary property manager, the Michigan Department of Technology, Management, and Budget (DTMB) was contacted to provide a base listing of owned and leased facilities. Leased property is included under the assumption that a location rendered unusable by disaster would still require the state to seek alternate facilities as a replacement.

While most buildings and their valuations included surrounding landscaping, facilities that could not be easily separated from the high value of large surrounding timberlands (such as some state park facilities) were removed so as not to unduly skew data. This means counties with facilities that are part of state parks will be somewhat underrepresented in the following table. Unimproved properties, as well as stand-alone parking areas not involving multi-level structures, were also not included.

Because the state heavily relies on self-insurance for its buildings, valuation replacement costs were typically not known and were calculated based on their square footage as multiplied by $253 per square foot. This value was adjusted by DTMB for certain types of facilities based on their function and anticipated deviation from typical building design. The resulting valuations may be less than true replacement costs and does not include indoor furnishings or equipment. State owned communication towers were also included and estimated using different methodologies as non-inhabitable structures.

State properties not managed by DTMB were also contacted for inclusion, such as the State Capitol, Senate/House offices, and those used by the Auditor General. The State Capitol is a large, historic structure that proved difficult to assess in a manner similar to other structures and is included here even though it represents a clear outlier. Its estimated replacement cost was pegged at $2 billion. Located in Ingham County, the county would still retain its top ranking (below) even if the Capitol was removed due to the value of other numerous state buildings. Whether the Capitol would be rebuilt in the same manner if it was destroyed is unknown. Less expensive options would present themselves to replace its functions, especially in the short run. The top ten counties based on estimated facility valuations are shown below, which when taken together represented roughly 66% of all Michigan owned or leased facility valuations.

Top 10 Counties, Estimated Valuation of State Facilities, 2022

County	Valuation	% of State
Ingham*	$3,485,521,633	24.6%
Jackson	$1,430,359,327	10.1%
Wayne	$1,198,484,977	8.5%
Washtenaw	$727,609,961	5.1%
Ionia	$601,458,679	4.2%
Crawford	$499,287,256	3.5%
Eaton	$489,219,148	3.5%
Branch	$368,350,588	2.6%
Chippewa	$344,654,449	2.4%
Marquette	$321,613,267	2.2%
Overall State Total:	**$14,172,545,809**	**100%**

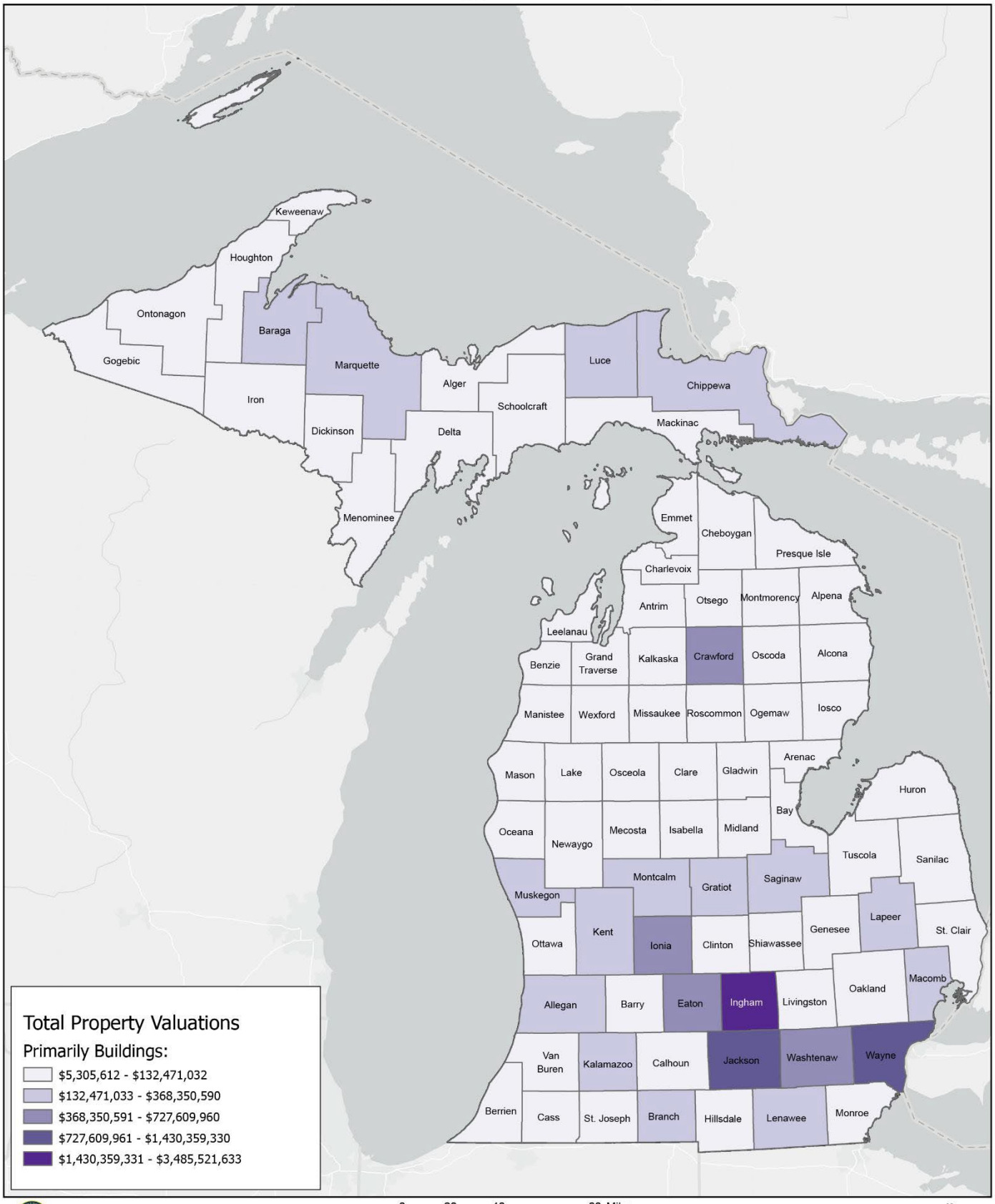
*incudes $2 billion State Capitol Building
(sources: Michigan State Capitol Commission, DTMB, and MSP/EMHSD)

Beyond Ingham, other counties with high valuations included Jackson County, which has several large prisons (counties with state prisons, sometimes multiple, ranked generally high). Wayne County also topped $1 billion due to the costs of providing state services to a highly populated area. Camp Grayling (a National Guard Readiness Center) elevated Crawford County in the rankings. Not shown, Kent County was ranked at number eleven ($315,876,765). Valuations for all counties are available later in this chapter.

An accompanying map (following page) shows the relative valuations for each Michigan county in comparison to one another. While some areas of the Upper Peninsula contained the lowest valuations for any county, several state prisons are also located in the region.

State Owned or Leased Property Valuations (2022)

Primarily Buildings, Includes State Capitol



Estimated Annual Loss (State Facilities, By County)

The NRI was used to determine the Estimated Annual Loss (EAL) for each county attributable to a select group of natural hazards. The following listing is based on a modeling assumption that a similar pattern of damage to state facilities (primarily buildings) within a county would exist as seen for the county as a whole. The county with the greatest EAL for state facilities was Wayne County, followed by the counties of Ingham, Washtenaw, Jackson, Oakland, Macomb, Kent, Kalamazoo, and Eaton. These rankings are consistent with expectations that EAL is generally higher in the southern portions of the state due a variety of factors (e.g., increased tornado prevalence, pluvial flooding damage). Some counties, such as Ionia and Crawford, had a relatively lower EAL despite their high valuation of state facilities because of a lower frequency of damaging natural hazards (as determined by NRI data).

COUNTY	STATE FACILITIES VALUE	ESTIMATED ANNUAL LOSS
Alcona	$6,175,491	$4,000
Alger	$87,417,226	$16,200
Allegan	$219,414,275	$1,902,005
Alpena	$16,131,090	$11,886
Antrim	$7,149,811	$5,322
Arenac	$82,895,509	$97,777
Baraga	$145,184,313	$39,759
Barry	$21,201,972	$161,861
Bay	$62,963,342	$838,384
Benzie	$33,414,321	$21,187
Berrien	$65,839,415	$582,268
Branch	$368,350,588	$1,823,101
Calhoun	$43,159,765	$645,687
Cass	$41,593,453	$159,391
Charlevoix	$9,781,053	$5,524
Cheboygan	$24,067,516	$31,566
Chippewa	$344,654,449	$396,484
Clare	$12,762,342	$45,164
Clinton	$40,027,422	$499,382
Crawford	$499,287,256	$1,128,034
Delta	$53,058,061	$45,255
Dickinson	$22,253,997	$20,729
Eaton	$489,219,148	$7,048,371
Emmet	$32,330,387	$24,561
Genesee	$99,289,140	$3,857,613
Gladwin	$12,317,475	$23,160
Gogebic	$76,278,120	$55,913
Grand Traverse	$98,972,904	$415,319
Gratiot	$225,781,893	$1,625,792
Hillsdale	$6,490,908	$48,367
Houghton	$54,573,334	$9,708
Huron	$12,286,559	$53,242
Ingham	$3,485,521,632	$98,451,018
Ionia	$601,458,679	$6,137,651
Iosco	$11,883,318	$19,027
Iron	$45,420,840	$28,707
Isabella	$20,711,405	$217,928
Jackson	$1,430,359,327	$27,404,200
Kalamazoo	$258,500,331	$7,737,890
Kalkaska	$19,959,650	$29,020
Kent	$315,876,765	$13,238,883
Keweenaw	$5,305,612	$171

COUNTY	STATE FACILITIES VALUE	ESTIMATED ANNUAL LOSS
Lake	$10,897,361	$8,403
Lapeer	$170,707,567	$2,415,872
Leelanau	$5,563,285	$5,005
Lenawee	$183,295,732	$2,290,547
Livingston	$36,912,884	$1,219,953
Luce	$205,307,796	$53,157
Mackinac	$35,551,900	$14,075
Macomb	$169,114,821	$18,444,100
Manistee	$108,426,202	$85,981
Marquette	$321,613,267	$1,705,330
Mason	$6,561,362	$11,252
Mecosta	$16,310,369	$77,939
Menominee	$8,540,398	$9,722
Midland	$22,267,890	$309,559
Missaukee	$11,807,603	$16,548
Monroe	$22,002,261	$471,552
Montcalm	$179,008,724	$1,929,194
Montmorency	$30,243,774	$31,715
Muskegon	$301,289,534	$2,276,660
Newaygo	$10,186,718	$31,310
Oakland	$132,471,033	$20,005,561
Oceana	$9,155,807	$17,322
Ogemaw	$12,763,270	$31,964
Ontonagon	$7,272,908	$1,406
Osceola	$24,318,775	$62,750
Oscoda	$17,795,790	$31,992
Otsego	$40,353,612	$115,153
Ottawa	$16,907,822	$331,888
Presque Isle	$7,882,757	$3,896
Roscommon	$24,907,275	$81,632
Saginaw	$228,859,254	$4,196,145
Sanilac	$26,195,977	$136,818
Schoolcraft	$50,667,953	$9,305
Shiawassee	$21,711,422	$264,771
St. Clair	$7,002,399	$103,385
St. Joseph	$27,830,670	$129,371
Tuscola	$119,009,973	$882,389
Van Buren	$52,923,391	$367,046
Washtenaw	$727,609,961	$29,259,802
Wayne	$1,198,484,977	$173,981,765
Lake	$10,897,361	$8,403
TOTAL	$14,172,545,809	$436,399,033

Section 2: Jurisdictional Assets (County)

Beyond state owned and leased facilities, information obtained from FEMA's Hazus database was used to identify other categories vulnerable to hazards, such as general jurisdictional building stock and population. While an overall state focused plan, the MHMP uses counties as base jurisdictions for parts of this document.

The listing below includes an aggregate number of structures from most typical building categories, including residential, commercial, industrial, and agricultural. Counties are ranked based on the highest dollar value of exposed building stock, although a high correlation based on vulnerable populations can also be seen to exist.

County	Vulnerable Population	Vulnerable Buildings	Value of Exposed Buildings
Wayne	1,781,024	706,927	$315,196,646,222
Oakland	1,267,083	475,444	$282,014,205,962
Macomb	890,926	332,571	$165,010,150,829
Kent	661,190	234,498	$122,787,020,175
Washtenaw	372,435	125,629	$79,522,693,230
Genesee	411,625	176,027	$74,073,923,061
Ottawa	288,908	112,939	$56,375,253,027
Ingham	279,580	95,896	$49,700,983,799
Kalamazoo	262,459	97,299	$48,551,312,637
Livingston	195,513	86,890	$44,948,989,059
Saginaw	188,921	82,345	$36,579,464,391
Berrien	155,527	78,413	$33,960,200,866
Monroe	155,941	65,547	$33,935,986,744
St. Clair	159,462	69,041	$30,176,115,419
Jackson	160,300	70,696	$29,565,028,248
Muskegon	177,982	73,194	$29,210,876,129
Allegan	127,666	68,326	$28,853,020,894
Calhoun	134,479	58,380	$25,651,546,834
Eaton	110,991	45,029	$22,536,931,626
Bay	104,486	46,422	$19,968,050,886
Lapeer	89,301	46,839	$19,627,505,607
Lenawee	99,123	47,177	$19,596,216,964
Grand Traverse	95,304	48,802	$19,322,602,231
Midland	82,646	37,406	$18,083,198,724
Isabella	64,519	24,879	$16,221,038,564
Montcalm	64,796	33,516	$15,986,667,139
Clinton	84,358	34,743	$15,640,740,331
Marquette	65,880	28,837	$14,069,673,313
Barry	61,588	38,260	$13,867,606,887
Van Buren	72,077	35,641	$13,717,859,429
St. Joseph	60,018	29,072	$13,069,057,711
Ionia	66,413	31,121	$12,697,402,134
Cass	51,310	26,047	$12,038,488,133
Huron	31,589	20,397	$11,428,154,403
Tuscola	51,574	27,029	$11,143,001,645
Shiawassee	66,345	21,129	$10,895,328,100
Chippewa	37,099	20,506	$10,478,458,479
Emmet	33,378	21,234	$10,415,770,281
Hillsdale	46,197	31,631	$10,340,430,830
Newaygo	49,046	25,554	$10,180,552,189
Sanilac	40,253	22,322	$10,147,332,225
Mecosta	40,033	20,781	$10,100,114,590
Cheboygan	26,259	25,355	$9,510,763,482
Branch	45,066	20,596	$9,471,331,301
Delta	36,938	19,926	$9,289,171,018
Gratiot	42,901	16,770	$8,798,633,653
Charlevoix	26,176	18,603	$8,303,327,609
Roscommon	23,143	24,090	$8,009,346,834

County	Vulnerable Population	Vulnerable Buildings	Value of Exposed Buildings
Mason	29,078	17,091	$7,902,138,967
Iosco	25,215	18,980	$7,772,441,664
Houghton	37,383	18,578	$7,687,768,560
Antrim	24,044	18,923	$7,583,673,289
Wexford	32,622	17,437	$7,576,140,711
Leelanau	22,035	17,218	$7,399,368,399
Otsego	24,564	14,854	$7,364,690,065
Oceana	25,586	16,681	$7,254,320,417
Clare	31,490	18,746	$7,189,648,822
Alpena	28,956	15,232	$6,869,403,133
Dickinson	25,985	15,209	$6,814,682,943
Gladwin	25,419	19,680	$6,595,660,095
Manistee	25,047	15,694	$6,028,569,196
Menominee	23,359	13,461	$5,914,338,145
Ogemaw	20,074	14,561	$5,620,934,149
Benzie	18,837	12,822	$4,860,474,811
Arenac	15,752	12,046	$4,559,919,457
Kalkaska	17,343	12,765	$4,556,618,364
Osceola	22,481	10,709	$4,545,332,078
Presque Isle	12,814	13,840	$4,495,764,166
Mackinac	10,500	10,820	$4,411,459,829
Alcona	10,443	14,898	$4,100,558,345
Missaukee	15,548	9,741	$4,064,668,753
Gogebic	14,455	11,354	$3,747,388,789
Lake	12,721	13,858	$3,719,683,587
Montmorency	9,226	12,817	$3,567,491,263
Crawford	13,388	11,417	$3,310,212,285
Iron	11,602	9,747	$3,188,411,454
Oscoda	8,102	10,306	$3,104,146,648
Alger	8,920	8,616	$2,805,772,530
Luce	5,333	5,818	$2,107,045,259
Schoolcraft	7,962	5,600	$2,059,651,108
Baraga	8,205	4,891	$1,842,493,071
Ontonagon	5,724	5,269	$1,629,606,118
Keweenaw	1,951	2,298	$614,088,194
TOTAL			$2,053,932,738,508

Additional information related to county populations and geographic development trends is located in Appendix 2. Primary county hazard information can be found in the MHA, as well as in Chapter 4 and Appendix 7 of this publication.

Section 3: Critical Infrastructure

Not all building stock is deemed as critical infrastructure, and the types of critical infrastructure considered in the MHMP go beyond just buildings (e.g., dams, bridges). The Homeland Infrastructure Foundation-Level Data (HIFLD) working group makes certain infrastructure data publicly available in a manner not deemed as a risk to national security. Categories are broken out for facilities such as emergency operations centers, fire stations, hospitals, and critical water infrastructure.

While HIFLD does not contain estimated dollar replacement values, the FEMA Geographic Information System (GIS) tool known as the Hazus Comprehensive Data Management System calculates these values for some types of facilities. It should be noted that the term “critical” when applied to a facility type may not include all existing facilities within a category (based on their relative size or other factors). Equally, some included facilities may vary greatly in terms of how their costs are calculated, as well as their importance (for example, different fire stations have variable equipment, capability levels, and coverage areas). The tool offers the best available data and allows for some general comparisons to be made from category to category.

The following facility types were chosen for summarization of critical infrastructure. Replacement value estimates are provided where available. The Michigan Department of Environment, Great Lakes, and Energy (EGLE) was contacted for information related to dams. More detailed information related to dams is included in Appendix 8 of this publication as well as within the Dam and Levee Failures chapter of the MHA.

Select Critical Infrastructure by Category

Facility Type	Number of Facilities	Replacement Value Estimate (if available)	Data Source
Agriculture	109	N/A	HIFLD
Banking (FDIC Insured Banks)	1,087	N/A	HIFLD
Commercial	17	N/A	HIFLD
Communication	487	$51,622,000,000	Hazus
Dams	2,592	N/A	EGLE
Emergency Operations Centers	146	$664,921,000,000	Hazus
Energy (Not Including Nuclear)	288	$92,387,730,000,000	Hazus
Fire Stations	1,444	$1,754,394,000,000	Hazus
Hospitals	197	$20,894,933,000,000	Hazus
Nuclear Power Plants*	3	N/A	HIFLD
Police Stations	709	$5,557,829,000,000	Hazus
Water	500	$63,928,697,000,000	Hazus
Total of Available	**7,579**	**$185,240,126,000,000**	

*Two nuclear power plants currently operating, one seeking relicensing at the time of this writing.

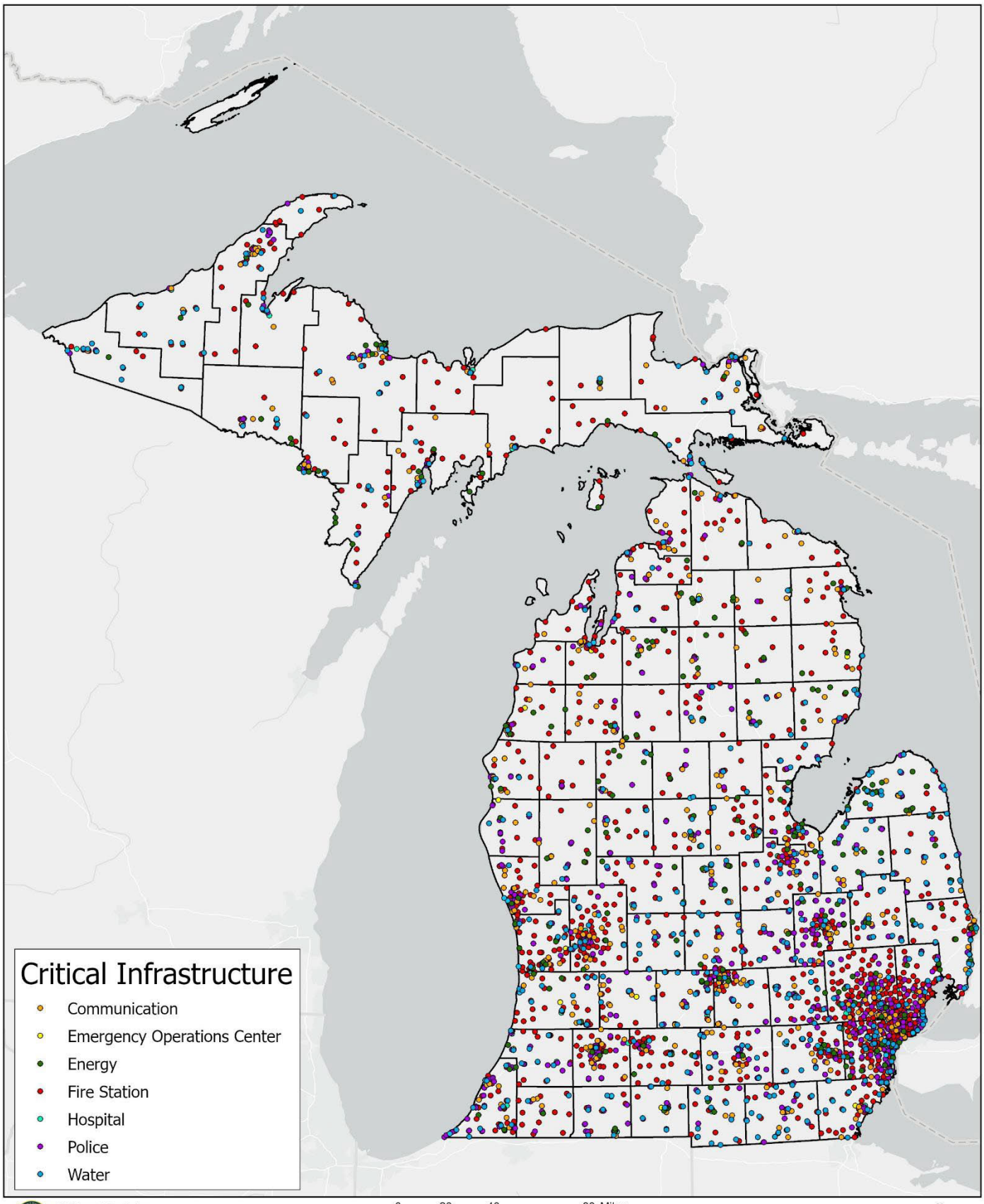
Transportation related infrastructure is presented separately (below) due to the wide variety of its assets, the fact that highways and railways are categorized as segments as opposed to facility plot points, and in order to provide for less congested maps. Additional information is included in the Major Transportation Incidents chapter of the MHA.

Select Transportation Infrastructure by Category

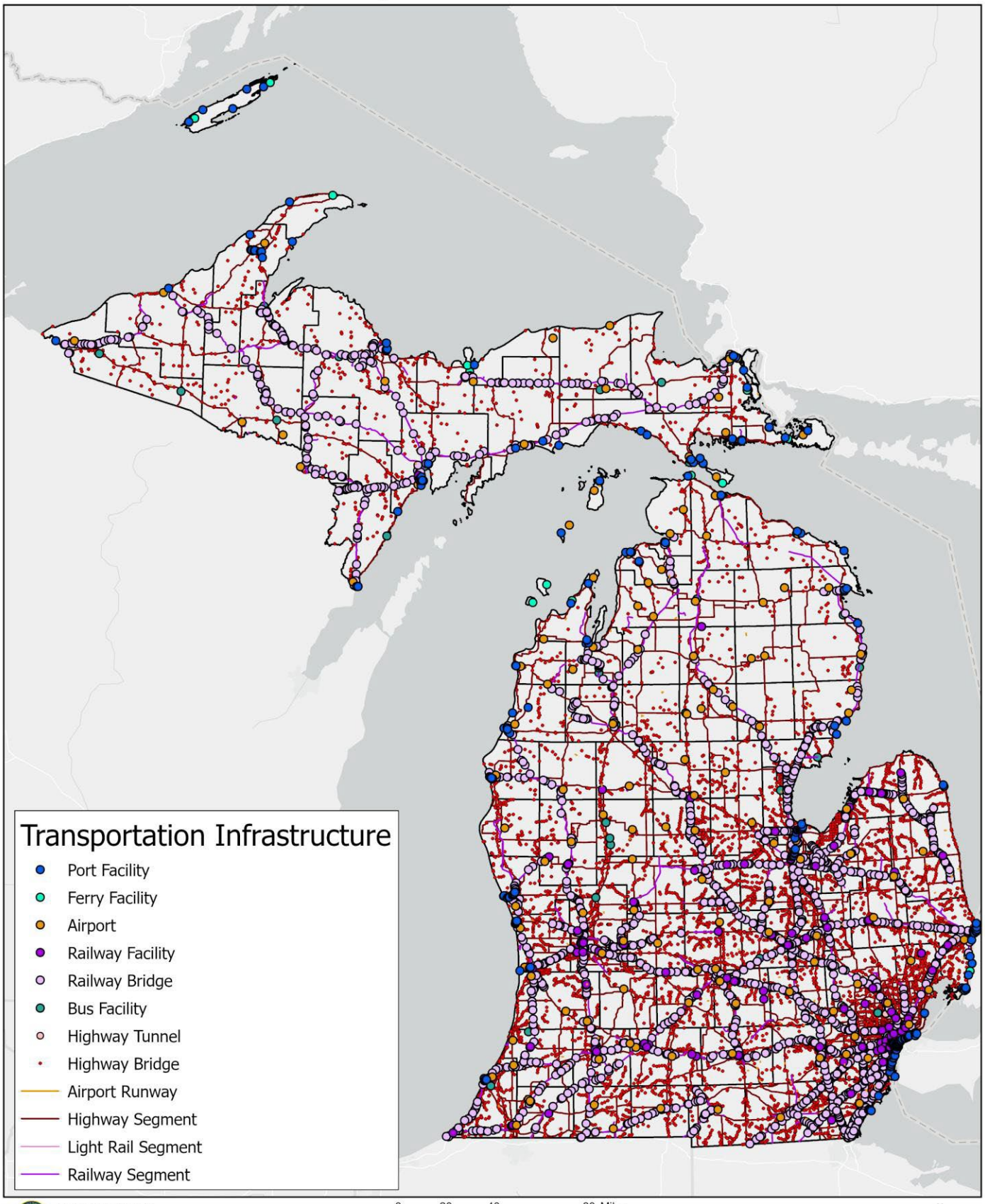
Infrastructure Type	Replacement Value Estimate	Data Source
Highway Segments	$96,750,176,836	Hazus
Highway Bridges	$30,085,609,653	Hazus
Highway Tunnels	$292,032,668	Hazus
Bus Facilities	$97,279,670	Hazus
Airport Runways	$1,675,037,890	Hazus
Airport Facilities	$1,963,822,670	Hazus
Railway Segments	$46,549,478,114	Hazus
Railway Bridges	$10,201,280,000	Hazus
Railway Facilities	$322,223,000	Hazus
Light Rail Segments	$83,645,374	Hazus
Port Facilities (water)	$980,588,701	Hazus
Ferry Facilities	$42,592,000	Hazus
Total of Available	**$189,043,766,576**	

Maps plot the general locations of critical infrastructure, including for transportation, on the following pages. More specific information related to the exact addresses of critical infrastructure and key resource locations within Michigan is not included for security reasons (e.g., terrorism, criminal activity, trespass, vandalism). Facilities deemed as military assets, whether state or federal, are typically not highlighted. However, many airports may be used for both commercial and military purposes under certain situations and are included below. Some port facilities may also be used by the armed forces while performing their duties.

Critical Infrastructure



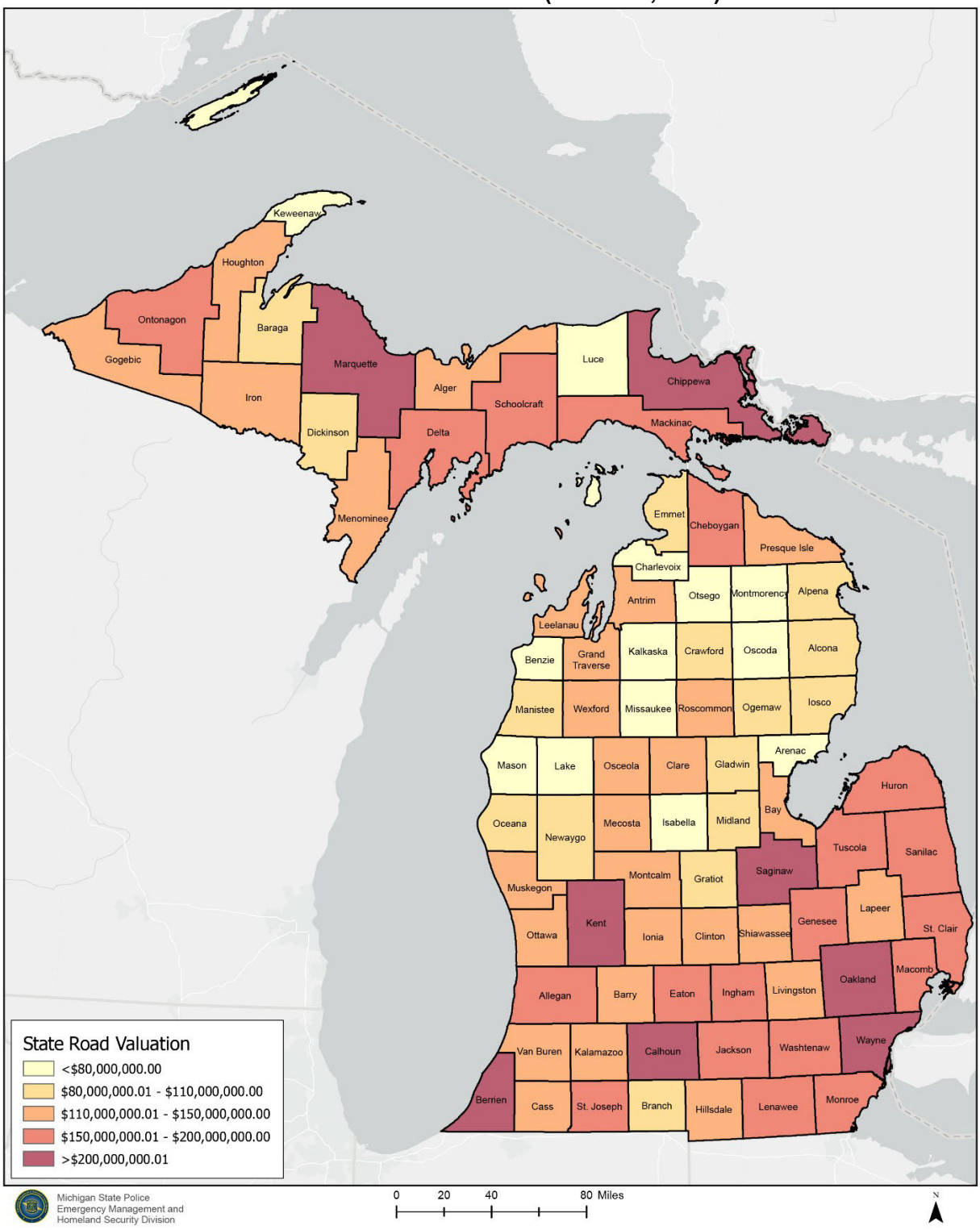
Transportation Infrastructure



State Roads and State Bridges

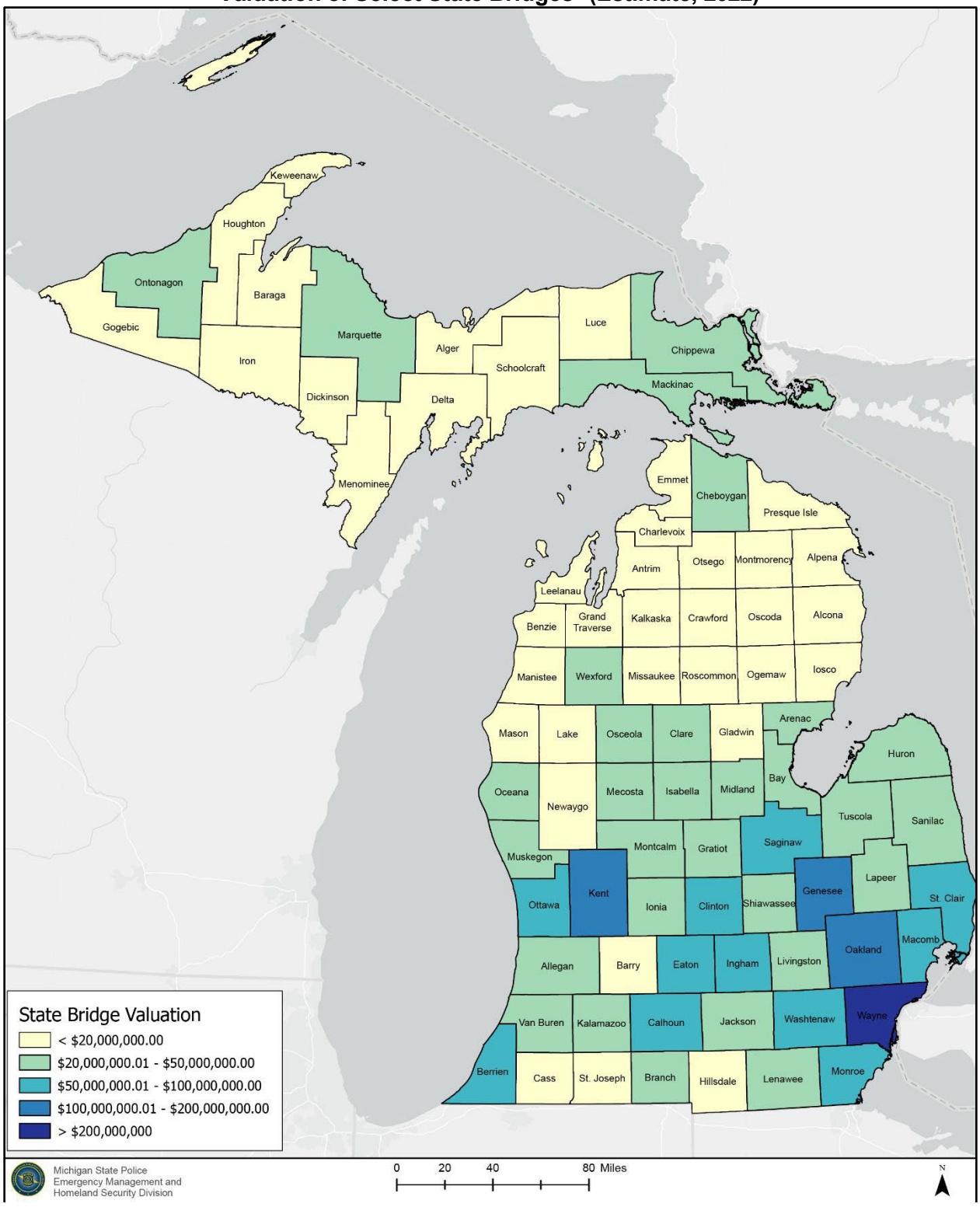
Estimated values for state roads and bridges were provided by the Michigan Department of Transportation (MDOT) for all 83 counties. Figures were compiled using historical construction costs per the Government Accounting Standards Board (as opposed to present value replacement costs, currently unavailable). While values based on historical construction costs are significantly lower than replacement valuations, they can be useful in identifying which counties have a proportionally higher amount of state roads and bridges. Simplified figures used modeling that assumes each mile of road as having the same cost, regardless of the construction method/material used. As expected, southeast Michigan has some of the highest values. Areas with significant state road valuations also exist in the Upper Peninsula due to a relative lack of federal roads.

Valuation of State Roads (Estimate, 2022)



Similar simplified modeling was used for bridges, defined as a span over 20 feet in length. Saginaw County is underrepresented using this methodology because of its 8,000-foot long Zilwaukee Bridge, a notable outlier in terms of typical (average) bridge length in the state.

Valuation of Select State Bridges* (Estimate, 2022)



* The International, Blue Water, and Mackinac bridges are specifically not included in map results to avoid skewing data (reported separately, next page).

Valuation estimates for especially critical bridges are provided separately due to their importance as they relate to trade and tourism. The bridges vary significantly based on size and construction type.

Select Critical Bridge Valuations (Publicly Owned In Whole/Part By Michigan)

Bridge	Estimate Replacement Costs, US Dollars
International Bridge (international)	$145 million (Michigan share estimated at $72.5 million)
Mackinac Bridge	$4 billion (suspension bridge spanning two peninsulas)
Blue Water Bridge (international)	$700 million (Michigan share estimated at $350 million)

(source: MDOT and associated bridge authorities)

Similar infrastructure located on Michigan borders that are not publicly owned by the state includes the Ambassador Bridge (privately owned), as well as the Gordie Howe International Bridge (under construction at the time of this writing and being built by the Canadian government). Both bridges are located in Detroit.

In a unique category but important to note, the Soo Locks lay between Michigan's Upper Peninsula and Ontario, Canada. The locks are operated and maintained by the United States Army Corps of Engineers (USACE), with a new parallel lock also having been authorized by Congress for the same location. The Soo Locks are in the same proximal area as the International Bridge in Sault Ste. Marie.

Chapter 4: Hazard Overview and Frequency Summary

Mitigation plan requirements as determined by FEMA policy guidance include an overview of natural hazards that typically impact the state. Although Michigan is generally not susceptible to the catastrophic effects of major earthquakes and hurricanes, it is still a heavily populated state with substantial amounts of built infrastructure vulnerable to more routine (but still damaging) natural hazards. This chapter begins by listing the natural hazards considered in this plan, as well as summarizing their frequency and impact potential as taken from the National Centers for Environmental Information (NCEI) Storm Events Database. Additional analysis is considered based on the contents of local hazard mitigation plans, climate change, equity, and other factors. Although not a requirement of FEMA, the MHMP also analyzes select emergency management related technological and human-related hazards.

Section 1: Natural Hazards Overview

The separately published MHA is a companion white paper and technical document also used as an official attachment to inform this plan. The MHMP includes summarized data from the MHA as a starting basis for the materials in this chapter. Categories for natural hazards include:

- **Lightning** (part of thunderstorm analysis)
- **Hail** (part of thunderstorm analysis)
- **Tornadoes** (part of thunderstorm analysis)
- **High winds** (non-tornadic; frequently referred to as straight line winds)
- **Snow** (to include blizzards and squalls)
- **Freezing rain and sleet** (freezing rain is frequently referred to as ice storms)
- **Extreme cold**
- **Fluvial and pluvial flooding** (part of a broad flooding analysis)
- **Great Lakes shoreline hazards** (also encompasses flooding)
- **Dam and levee failures** (a quasi-technical hazard treated here as part of a broad flooding analysis)
- **Extreme Heat**
- **Drought**
- **Wildfires**
- **Invasive species**
- **Earthquakes**
- **Subsidence**
- **Meteorites** (including other impacting celestial objects, some being human made)
- **Space weather** (such as solar flares)

The MHA aggregates data for some hazard categories in order to provide a more straightforward analysis. For example, NCEI figures for “Ice Storm” and “Sleet” are combined as part of “Freezing Rain” in the following table:

Reported Damaging Events, Select NCEI Categories (Michigan, 1/1/1996 - 4/30/2023)

Corresponding MHA Category	Reported Damaging Events	Total Property Damage Estimates	Deaths	Injuries
Floods	1,413	$3,140,642,000	12	8
High Winds	10,415	$1,163,454,097	42	282
Tornadoes	458	$445,697,030	9	210
Hail	4,508	$394,128,300	0	5
Freezing Rain	432	$316,774,000	2	5
Snow	9,549	$62,306,500	2	10
Wildfire	28	$19,686,000	0	4
Lightning	318	$18,343,000	18	117

(source: NCEI and MHA Chapters; See relevant MHA hazard chapters for category aggregation)

Flooding is the highest ranked hazard category based on property damages, with high winds (non-tornadic) coming in second. On a per incident basis, tornadoes are more damaging than high wind events but happen much less frequently. Hail comes close to meeting tornado damage totals, but an outlier hail event accounts for much of its damages over this time period (outlier events are not unique to hail). Data from such outlier events may give the impression that a hazard typically causes more damage in multiple locations across the state than it actually does. Outliers also serve as a reminder that significant events of an infrequent nature can and do happen (and may be quite costly despite their relatively rare occurrence).

Due to the nature of NCEI reporting, wildfires are underrepresented (more information is available in the MHA's Wildfire Chapter). The number of events reported for lightning may appear low, but it should be kept in mind that routine, non-damaging lightning is not being considered. As highlighted in the table below, the death rate from the included lighting events is higher per event than for the other hazards being considered.

Hazard analysis based on injury ranking appears on the following page (including for Extreme Heat and Extreme Cold, whose property damage totals are not reliably reflected in the NCEI database).

Reported Damaging Events, Select NCEI Categories (Michigan, 1/1/1996 - 4/30/2023)

Hazards, Ranked by # of Injuries	Reported Events	Significant Injuries	Deaths	Injuries Per Event	Deaths Per Event
Extreme Heat	318	**882**	8	2.7736	0.0252
High Winds	10,415	**282**	42	0.0271	0.0040
Tornadoes	458	**210**	9	0.4585	0.0197
Extreme Cold	915	**200**	29	0.2186	0.0317
Lightning	318	**117**	18	0.3679	0.0566
Snow	9,549	**10**	2	0.0010	0.0002
Floods	1,413	**8**	12	0.0057	0.0085
Freezing rain	432	**5**	2	0.0116	0.0046
Hail	4,508	**5**	0	0.0011	0.0000
Wildfire	28	**4**	0	0.1429	0.0000
Ranked by Injury Ratio					
Extreme Heat	318	882	8	**2.7736**	0.0252
Tornadoes	458	210	9	**0.4585**	0.0197
Lightning	318	117	18	**0.3679**	0.0566
Extreme Cold	915	200	29	**0.2186**	0.0317
Wildfire	28	4	0	**0.1429**	0.0000
High Winds	10,415	282	42	**0.0271**	0.0040
Freezing rain	432	5	2	**0.0116**	0.0046
Floods	1,413	8	12	**0.0057**	0.0085
Hail	4,508	5	0	**0.0011**	0.0000
Snow	9,549	10	2	**0.0010**	0.0002

(source: NCEI and MHA Chapters; See relevant MHA hazard chapters for category aggregation)

These stacked tables display the same data but are ranked by different criteria. They demonstrate the effects that both extreme heat and extreme cold can have on individuals, both independently and as a consequence of associated hazards (e.g., snow may still trap people in frigid vehicles, high winds contribute to wind chill). Looking at injuries and not deaths, extreme heat ranks the highest in both tables, with wind related events coming in second and third for the overall numbers of injury. Tornadoes in particular were ranked notably high on both lists.

Extreme heat events were the only hazard that, on average, resulted in more than one injury per event. Tornadoes approached "half" an injury on average, per event, followed by lightning. Reported lightning events involved a death at the highest rate, not surprising given that a reported death may have been the only reason the incident was included in the database.

While past data can be helpful for general educational purposes, changing climate conditions are expected to impact what might have otherwise been continued trends going forward. Some changes (e.g., more days with a higher potential for extreme heat) seem obvious. Other changes, like the frequency of "off season" tornadoes, or the future severity of thunderstorms in the state, require more nuanced considerations. See Appendix 3 for additional information as it relates to changing weather patterns as a result of climate change.

A summary for NCEI data by geographic division (Chapter 2) is useful for determining frequency but has some limitations due to the manner in which large storms may overlap multiple counties or broader regions. The following tableôs first column represents a typical countyôs historical average (frequency) of occurrence for the specific geographic division it resides in, with the number of events having been divided by the roughly 27-year time period being considered (1996 through April 30, 2023). Due to rounding, a zero should not be interpreted as an event, injury, or death having never occurred.

State Summary by Geographic Division (1/1/1996 - 4/30/2023)

	Average annual events per county in division	Average annual deaths	Average annual injuries	Average annual property and crop damage	Average annual events	Average annual deaths	Average annual injuries	Average annual property and crop damage
Geographic Division→	**Metropolitan / Detroit**				**Southern Lower Peninsula**			
Lightning	.9	.2	1.4	$357,519	.1	.1	1.6	$231,211
Hail	5.6	0	0	$915,843	2.2	0	.1	$9,404,823
Tornadoes	.3	0	3.6	$6,082,034	.3	.2	2.3	$ 7,855,587
High Winds	14.9	.4	1.9	$12,275,229	6	.8	6	$28,126,921
Snow	2.2	0	.2	$947,091	2.9	0	0	$919,319
Freezing Rain and Sleet	.2	0	.1	$6,530,809	.2	0	0	$3,330,223
Extreme Cold	.6	.8	2.9	$221,368	.2	.1	4.4	$1,084,888
Flooding	2	0	0	$78,885,108	.7	.3	.3	$26,250,823
Extreme Heat	.6	.3	29.9	$0	.2	0	2.4	$0
Wildfires*	.1	0	0	$732	0	0	0	$0
Geographic Division→	**Northern Lower Peninsula**				**Upper Peninsula**			
Lightning	.1	.2	1	$38,511	.1	.1	.2	$43,900
Hail	1.1	0	0	$1,582,894	2	0	0	$2,981,632
Tornadoes	.1	.1	1.8	$2,132,237	.1	0	0	$293,450
High Winds	1.9	.2	2.2	$3,881,742	3.4	.1	.2	$933,434
Snow	3.3	0	0	$731,797	9.7	.1	.1	$141,639
Freezing Rain and Sleet	.1	0	0	$139,407	.3	0	0	$11,591,621
Extreme Cold	.1	0	0	$2,725,942	1.4	.1	0	$0
Flooding	.3	0	0	$3,220,966	.9	.1	0	$7,927,845
Extreme Heat	.1	0	0	$0	.1	0	0	$0
Wildfires*	0	0	0	$85,620	0	0	.1	$670,545

(source: NCEI Storm Events online database; *wildfires are poorly predicted by NCEI data)

In many cases, the amount of building and infrastructure in an area, often driven by population, determines the potential for losses. The largest damage amounts are seen in the categories of Metro Detroit floods, Metro Detroit winds, Southern Lower Peninsula floods, and Southern Lower Peninsula hail. It should be noted however that NCEI data has some gaps and limitations and is a poor indicator for wildfire frequency. NCEI data for drought also has limited utility as would be used in this table and is not included (the MHA chapter on drought contains relevant information).

Focused County Considerations

The following table ranks counties for each of the hazards that were able to be quantitatively assessed in the MHA during this same time period but includes only those counties where estimated expected annual damages amounted to at least $1 million for the corresponding hazard. As will be later discussed, some weather impacts to these counties may also be indicative of vulnerability potential for nearby counties of similar size and infrastructure.

Top Counties Ranked by Annualized Damages (1/1/1996 - 4/30/2023; $1 Million Threshold)

County Ranking	Flood Impacts	High Wind Impacts	Tornado Impacts	Hail Impacts	Freezing Rain/ Sleet Impacts	Drought Impacts
1	Wayne	Wayne	Wayne	Kalamazoo	Oakland	Wayne
2	Oakland	Kent	Monroe	Marquette	Macomb	*
3	Macomb	Oakland	Otsego	Van Buren	*	*
4	Midland	Macomb	Eaton	Ogemaw	*	*
5	Houghton	Ottawa	Macomb	*	*	*
6	Isabella	Washtenaw	*	*	*	*
7	Ottawa	Calhoun	*	*	*	*
8	Gogebic	Muskegon	*	*	*	*
9	*	Genesee	*	*	*	*
10	*	St. Clair	*	*	*	*
11	*	Livingston	*	*	*	*
12	*	Saginaw	*	*	*	*
13	*	Kalamazoo	*	*	*	*
14	*	Montcalm	*	*	*	*

(source: adapted from NCEI data and the MHA)

No Michigan counties had annual expected losses of more than $1 million in property damages from lightning, snowstorms, extreme cold, wildfires, or extreme heat. The inclusion of crop related damages for drought, limited in the NCEI, should not drive decision making in this area. Additional details are available in the MHA Drought Chapter.

When analyzing localized areas, it is important to assess whether some counties are more vulnerable because of an identifiable risk factor (e.g., location, topography, population) or if some hazards occurred purely by chance (this is especially true over shorter time horizons). For example, we would expect far northern counties, all other things being equal, to be generally colder than Wayne County. But if Kalamazoo County experienced more damaging hail than adjacent Calhoun County it is not as clear cut. Is Kalamazoo truly more likely to experience more damaging hail, or is Calhoun in some way relatively immune? In this case, because severe hail comes from strong thunderstorms and the incidence of such thunderstorms is similar for the two counties, the answer is likely that any heavy damages in the Kalamazoo area were due more to chance when compared to nearby Battle Creek (Calhoun County). Recent damage history is therefore just one consideration. With that caveat, top individual counties' results are presented in the following list (based only on annual historic property damages):

Top Annualized County/Hazard Combinations (1/1/1996 - 4/30/2023; $1 Million Threshold)

Wayne Flooding	$48,638,858	Ottawa High Winds	$2,153,165
Oakland Flooding	$14,954,482	Ottawa Flooding	$1,952,616
Macomb Flooding	$14,905,781	Van Buren Hail	$1,844,859
Midland Flooding	$12,047,933	Eaton Tornadoes	$1,842,554
Wayne Drought (crop)	$5,488,474	Otsego Tornadoes	$1,837,761
Kalamazoo Hail	$4,764,179	Washtenaw High Winds	$1,825,467
Houghton Flooding	$4,468,350	Calhoun High Winds	$1,716,429
Oakland Freezing Rain	$4,334,138	Muskegon High Winds	$1,677,653
Wayne High Winds	$3,873,070	Gogebic Flooding	$1,631,577
Wayne Tornadoes	$3,364,435	Genesee High Winds	$1,489,718
Kent High Winds	$3,185,950	St. Clair High Winds	$1,313,319
Isabella Flooding	$2,881,083	Livingston High Winds	$1,298,134
Oakland High Winds	$2,766,228	Macomb Tornadoes	$1,291,804
Macomb High Winds	$2,512,331	Saginaw High Winds	$1,286,462
Marquette Hail	$2,365,642	Ogemaw Hail	$1,192,828
Macomb Freezing Rain	$2,317,051	Kalamazoo High Winds	$1,051,738
Monroe Tornadoes	$2,227,516	Montcalm High Winds	$1,042,883

(source: adapted from NCEI data and the MHA)

Section 2: Technological and Human-Related Hazards

The NCEI database used in Section 1 covers only natural hazards, making ñapples to applesò comparisons via similar methodologies to technological and human-related hazards difficult. Such hazards covered in the MHMP include:

TECHNOLOGICAL HAZARDS

- **Hazardous materials** (fixed site incidents)
- **Nuclear power plant emergencies**
- **Hazardous materials** (transportation incidents)
- **Pipeline and wellhead incidents** (petroleum and natural gas)
- **Structure fires** (general, including urban conflagration)
- **Built infrastructure failures** (water, storm sewers, bridges, communications)
- **Major transportation incidents** (air, highway, rail, marine)
- **Energy failures and shortages** (electric, natural gas, petroleum)

HUMAN-RELATED HAZARDS

- **Terrorism and similar criminal incidents**
- **Cyberattacks and major network disruptions.**
- **Nuclear attack** (military, terrorist)
- **Public health emergencies** (contagions, food, and water contamination)
- **Civil disturbances**

Dollar value estimates for these hazards vary considerably for several reasons (e.g., lack of available data, difficulty in attributing to a specific state, different methodologies and accounting standards). While some hazard data is more obtainable (e.g., pipeline incidents), others are extremely challenging. Cyberattacks for example often go unnoticed, unreported, or are not revealed. Their damages are difficult to estimate and frequently not localized. The MHA includes some dollar estimations for these types of hazards, but not in a manner that is easily comparable to weather hazards.

Other tools are used to assess the relative risk potential for these hazards. A survey was taken in 2023 with 35 participants having subject matter expertise in emergency management, and asked to rank these hazards after considering frequency, impacts, and similar factors. Participants included the State Emergency Management Coordinators (SEMCs) for all state departments and agencies, as well as additional MSP/EMHSD personnel (including all eight District Coordinators) and two nonprofit organizations routinely involved in emergency declarations. Where select categories were considered too broad the survey included breakout categories (for example, pandemics and potable water emergencies as part of Public Health Emergencies).

A ranking of the results was presented to and accepted by the Hazard Mitigation Committee (HMC) of the Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC). These findings, as well as data from Section 1, were then carried over as part of a broader hazard analysis further detailed in Section 3 (next page). The top technological and human-related hazards, in rank order by general category, were:

1. **Infrastructure failure** (with an electric outage or energy shortage being the top infrastructure failure identified)
2. **Public health emergency** (with a pandemic being the top public health emergency identified)
3. **Terrorism** (with cyber related aspects being the top identified component)
4. **Internet Network Disruption** (part of a category that includes cyberattacks, but general internet disruptions also ranked high on their own merit)
5. **Hazardous materials** (with no clearly concludable specific hazardous materials category ranking as the top)

It should be noted that how to include the Coronavirus Disease 2019 (COVID-19) pandemic as part of the public health emergency category and Section 3 tables proved especially challenging. Seasonal influenza has a longer period of history, and it is currently unknown how COVID-19 will continue to present in the future. Michigan influenza estimates of roughly 1,750 deaths per year were provided by the Michigan Department of Health and Human Services (MDHHS), and although not all ñflu seasonsò are regarded as pandemics or public health emergencies, these figures were used as a baseline for public health emergency fatalities in this publication. While significantly waning, total COVID-19 deaths in Michigan stood at roughly 40,000 through January 2024. A newer COVID-19 variant, or an entirely different pandemic source, could therefore sustain a public health emergency fatality average well above influenzaôs 1,750 per year. Determining how to best account for COVID-19 data moving forward, potentially as a stand-alone hazard category, will be considered in the next iteration of this plan.

Section 3: Combined Hazard Summation and Analysis

Findings from Sections 1 and 2 were presented to the MCCERCC, which had also been presented with full chapters from the MHA. The following summary table generally lists hazards in chapter order and is ***not*** indicative of any ranking.

Hazard Analysis Summary Table (Michigan)

	Avg. annual events	Avg. annual deaths	Avg. annual injuries	Avg. annual property and crop damage	Development trend effects	Impact rating: economy	Impact rating: environment	Frequency in local plans
Lightning	**12**	**0.7**	**4.3**	**$0.7 million**	**=**	**0**	**1**	**Most**
Hail	**165**	**0**	**0.2**	**$14.9 million**	**+**	**2**	**1**	**Many**
Tornadoes	**17**	**0.3**	**7.7**	**$16.4 million**	**+**	**3**	**2**	**Many**
High winds	**381**	**1.5**	**10.3**	**$45.2 million**	**+**	**3**	**2**	**Most**
Snowstorms	**349**	**0.1**	**0.4**	**$3.0 million**	**+**	**2**	**1**	**Most**
Freezing rain / sleet	**15**	**0.1**	**0.2**	**$11.6 million**	**+**	**2**	**2**	**Most**
Extreme cold	**34**	**1.1**	**7.3**	**$5.0 million**	**=**	**2**	**1**	**Some**
Flooding* (includes from multiple categories and lakeshore flood data)	**52**	**0.4**	**0.3**	**$116.5 million**	**+**	**3**	**2**	**Most**
Dam and levee failures*					**+**	**2**	**2**	**Some**
Extreme heat	**12**	**0.3**	**32.0**	**None reported**	**+**	**1**	**1**	**Most**
Drought	**2**	**0**	**0**	**> $5.5 million**	**=**	**3**	**2**	**Many**
Wildfires	**> 1**	**> 0**	**0.2**	**$0.8 million**	**+**	**2**	**3**	**Many**
Invasive species	**< 1**	**< 1**	**> 1**	**Non NCEI**	**=**	**3**	**3**	**Some**
Earthquakes	**< 1**	**> 0**	**> 0**	**Non NCEI**	**=**	**1**	**1**	**Few**
Subsidence	**> 1**	**0**	**< 1**	**Non NCEI**	**=**	**0**	**1**	**Few**
Meteorites / impacting objects	**< 1**	**0**	**> 0**	**Non NCEI**	**+**	**U**	**U**	**None**
Space Weather (major)	**< 1**	**0**	**0**	**Non NCEI**	**=**	**U**	**0**	**None**
Hazardous materials (fixed site)	**> 1**	**> 1**	**> 7**	**Non NCEI**	**+**	**2**	**2**	**Many**
Nuclear power plants	**< 1**	**0**	**> 0**	**Non NCEI**	**=**	**U**	**U**	**Few**
Hazardous materials (transportation)	**> 1**	**> 1**	**> 1**	**Non NCEI**	**+**	**2**	**2**	**Many**
Pipeline and wellhead incidents	**> 1**	**> 1**	**> 1**	**Non NCEI (H)**	**+**	**2**	**2**	**Some**
Structure Fires (major)	**> 1**	**> 1**	**> 1**	**Non NCEI (H)**	**-**	**2**	**1**	**Many**
Built infrastructure failures	**> 1**	**< 1**	**< 1**	**Non NCEI**	**+**	**2**	**2**	**Most**
Transportation incidents (major)	**> 1**	**> 5**	**> 20**	**Non NCEI**	**+**	**2**	**0**	**Many**
Energy failures and shortages	**< 1**	**?**	**?**	**Non NCEI**	**+**	**3**	**1**	**Some**
Terrorism / similar criminal activities	**< 1**	**> 1**	**> 1**	**Non NCEI**	**=**	**2**	**0**	**Some**
Cyberattacks / network disruptions	**Many**	**< 1**	**< 1**	**Non NCEI**	**=**	**2**	**0**	**Few**
Nuclear attack	**0**	**0**	**0**	**Non NCEI**	**-**	**U**	**U**	**Few**
Public health emergencies**	**<20**	**>1,750**	**Many**	**Non NCEI (H)**	**-**	**3**	**1**	**Most**
Civil disturbances	**< 1**	**< 1**	**> 1**	**Non NCEI**	**=**	**1**	**0**	**Few**

* Flooding related chapters/data have been combined (e.g., excess rain, river flooding, dam breaches).

** Figures do not include from COVID-19, please see Section 2 of this chapter for details.

Average annual events, deaths, and injuries are primarily based on previously provided NCEI data, where available. Hazards without NCEI data are provided only as general estimates.

Average annual damages where NCEI data does not exist were also given a high (H) designation to indicate a high expectation of annualized costs for the same period greater than $50 million. This does not mean that other such hazards with unknown costs may not be equally damaging.

COVID-19: The pandemic has created great uncertainty on how public health emergencies should have events counted and costs calculated. For purposes of this plan, their annualized costs are being treated as high.

Development trend effects use symbols to estimate the effects of recent land use trends.

"+" means increasing risks, "=" means few net effects, "-" means decreasing risks.

Impact ratings are based upon the estimated severity of average annual impacts in Michigan (medium term):

"0" means negligible: the risks as currently known are not likely to result in large or widespread impacts.

"1" means moderate: a pattern of moderate widespread effects, or an infrequent chance of significant local impacts.

"2" means significant: a pattern of significant widespread effects, or an infrequent chance for major local impacts.

"3" means major: a pattern of significant or major widespread effects, or the potential to be state level in nature.

"U" means unlikely: The risks are unlikely in the medium term, but events, though rare, could be catastrophic.

Frequency in local plans estimates how many counties' plans list this as one of their top-10 hazards. Out of 77 counties with available ranked information, "Most" means at least 39 plans, "Many" means 16 to 38, "Some" means 6 to 15, and "Few" means 1 to 5. Weather hazards tend to be favored in local plans due to FEMA requiring their inclusion.

It should be noted that none of these hazards are considered insignificant, but that treating all hazards as having the same risk is not beneficial in helping to inform this plan's goals and objectives (especially when it comes to opportunities for meaningful state and local mitigation in areas of identified need). Some hazards, such as mitigation against meteorites, also lay more clearly within federal jurisdiction. All 31 listed hazard categories (below) are treated seriously and under the right conditions can create great harm. Indeed, some hazards near the bottom of any ranked listing tend to be of a lower probability for near-term catastrophic occurrence but can still carry devastating impacts under worse case scenarios.

Meetings with the MCCERCC HMC attempted to separately rank all hazards based on the totality of provided information and data. This was not done with the primary goal to present all hazards in a strictly ranked order, but rather to ensure that the committee felt contemplated goals and objectives were in alignment with the reality of Michigan's emergency management risk landscape and most relevant mitigation opportunities. These discussions went beyond the materials specifically provided for in this chapter and are represented throughout the plan to ensure factors such as future hazard events, climate change, population growth, communities of concern, equity, state assets, critical infrastructure, and threats near state borders were considered. Michigan's list for officially declared state and federal disasters, provided in the MHA, was also an important driving factor. The results of these meetings and discussions ended with the following rankings by category, aggregating the 31 hazard chapters of the MHA into four plan priorities. *Only those hazard categories assigned as having a "top" relative priority are listed in an express ranked order.*

Hazard Category, Relative Michigan Risk Priority

Hazard Category	Relative Priority	Hazard Category	Relative Priority
Floods: fluvial/pluvial	**Top**	Extreme cold	High
High winds	**Top**	Drought	High
Tornadoes	**Top**	Great Lakes shoreline	High
Public health emergencies	**Top**	Invasive species	High
Energy failures and shortages	**Top**	Lightning	Medium
Extreme heat	**Top**	Snowstorms	Medium
Cyberattacks and major network disruptions	High	Civil disturbances	Medium
Terrorism and similar incidents	High	Structure fires (general)	Medium
Freezing rain / sleet	High	Major transportation incidents	Medium
Pipeline and wellhead incidents	High	Space weather	Medium
Hazardous materials: fixed site	High	Earthquake	Lower
Dam and levee failure	High	Nuclear power plants	Lower
Hazardous materials: transportation related	High	Subsidence	Lower
Built infrastructure failure (road/bridge/water)	High	Nuclear attack	Lower
Hail	High	Meteorites/impacting objects	Lower
Wildfire	High		

To ensure a full spectrum of rankings, efforts were made to ensure that "lower" priority assignments included at least five hazard categories, and that the "top" priority assignments were limited to five. Ultimately, six hazards were placed into this "top" category, with extreme heat added as an exception primarily due to climate change and equity considerations. Some attempts were made to place other hazard categories into a ranked order, but in many cases differences were minor. Readers should therefore not interpret great total risk variability between the 14 hazards assigned as being a "high" priority. Drought was placed into the "high" risk category due to future concerns related to climate change.

As previously mentioned, the ranking process was designed to primarily ensure that the state's focused goals and objectives being contemplated for the MHMP reflected the state's emergency management landscape. In this regard, discussions included those components within a category that were considered most concerning. Pandemic potential for example tended to dominate and drive the ranking for the public health emergencies category.

Section 4: Seasonal Considerations

When analyzing annualized hazard frequencies some degree of seasonality can be expected for certain hazards. Although light snow sometimes falls during warmer months and other unusual events can occur, many hazards are strongly associated with particular times of the year. Beyond snow, winter hazards also see a seasonality with examples such as an increase in influenza. Hard frost on the other hand regulates mosquito borne illnesses.

This can generally be expressed by dividing the year into two risk periods: a winter risk season and a non-winter risk season. These can vary from region to region and year to year, but a general non-winter risk period is presented in the middle section of the following months:

March:	Final month for the highest-risk period involving influenza epidemics or pandemics
April:	Winter risk season (involving significant risk of extreme cold, snowstorms, blizzards, and ice/sleet storms) ends in the Lower Peninsula
May:	Winter risk season ends in the Upper Peninsula, non-winter risk season begins in the Lower Peninsula (involving a significant risk of extreme heat events, severe thunderstorms, lightning, hail, tornadoes, and wildfires)
Late May:	Non-winter risk season begins in the Upper Peninsula nd
Early September:	of the non-winter risk season in the Upper Peninsula
Late September:	Winter risk season begins in the Upper Peninsula, end of non-winter risk season in most of the Lower Peninsula
Early October:	End of non-winter risk season in the southernmost counties of the Lower Peninsula
October:	Start of the highest-risk period for influenza epidemics or pandemics
Early November:	Winter risk season begins in the Northern Lower Peninsula
Late November:	Winter risk season begins in the Southern Lower Peninsula

Floods occur throughout the year but are especially prevalent after the thawing of major snowpack accompanied by heavy precipitation.

It should be noted that climate change is altering these seasonal trends, and the information provided in this section is intended only to provide a general overview of the concept as it relates to hazard frequency and timing. See Appendix 3 for additional information on climate change.

Chapter 5: Mitigation Programs and Capabilities

Several important state capabilities are delivered through FEMA programs and grants. These may directly fund MSP/EMHSD's overall emergency management program or are specifically dedicated to funding hazard mitigation projects where they or other state partners act as a State Administrative Agency (SAA). Direct assistance for Michigan's emergency management program is provided via the Emergency Management Preparedness Grant (EMPG), which includes funding for several core capabilities (such as mitigation). Many programs where MSP/EMHSD is the SAA are grouped together as primary Hazard Mitigation Assistance (HMA) Programs, covered first here.

Section 1: Primary Hazard Mitigation Assistance Programs

References to HMA programs can be best thought of as an umbrella term for several specific grant programs that have been grouped together by FEMA and summarized under their HMA fact sheet.

Building Resilient Infrastructure and Communities

The Building Resilient Infrastructure and Communities (BRIC) Program was authorized by Sections 203 and 206 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), as amended (Pub. L. No. 93-288) (42 USC §§ 5133 and 5136). BRIC provides funding for states, local communities, and tribes to implement long-term hazard mitigation measures that reduce or eliminate risk to people and property from natural hazards and their effects. The program's guiding principles are to support communities through capability and capacity building, to encourage and enable innovation, promote partnerships, and enable large infrastructure hazard mitigation projects. Funding for BRIC is made available annually. The majority of BRIC funding is provided on a nationally competitive basis, but FEMA may also reserve a portion of funding as a set aside available to states and tribes.

The BRIC program is a state administered, cost-sharing program. Mitigation measures under BRIC are funded primarily on a 75% federal / 25% non-federal basis but in some instances may fund up to 90% federal share. Applications for BRIC grants are made via the FEMA Grants Outcomes system. The MCCERCC reviews all of the applications received and prioritizes applications. Final project selections and approvals are determined by FEMA.

Flood Mitigation Assistance Program

The Flood Mitigation Assistance (FMA) Program is a result of the federal National Flood Insurance Reform Act (NFIRA). The purpose of the NFIRA is to improve the financial condition of the National Flood Insurance Program (NFIP) and to reduce the federal expenditures for federal disaster assistance to flood damaged properties. With the passage of the NFIRA, Congress authorized the establishment of a federal grant program to provide financial assistance to states and local communities for flood mitigation planning and activities, resulting in the FMA Program. The somewhat related Repetitive Flood Claims (RFC) Program is now defunct but may still be referenced to in historical portions of this plan.

The FMA is a state administered, cost-sharing program through which FEMA provides assistance to reduce the risk of flood damage to structures insurable under the NFIP. The FEMA encourages states to assist local communities in prioritizing mitigation activities as outlined in their hazard mitigation plans and to fund projects that will greatly reduce the risk of flood damage to buildings, manufactured homes, and other NFIP-insurable structures. Mitigation of substantially damaged and repetitive loss structures is a high priority. Most mitigation measures under FMA are funded on a 75% federal / 25% non-federal basis, but in some instances for repetitive and severe repetitive loss properties the cost can be 90% or 100% federal. The MCCERCC reviews all of the applications received and prioritizes applications. FEMA determines final project approvals.

Hazard Mitigation Grant Program

The Hazard Mitigation Grant Program (HMGP) was created by Section 404 of the Stafford Act (PL 93-288, as amended). The HMGP provides funding for states and local communities to implement long-term hazard mitigation measures that reduce or eliminate risk to people and property from natural hazards and their effects. Funding for Michigan's HMGP is made available following a federal major disaster declaration in the state. The amount available to the state for HMGP projects is based on 15% of the federal funds expended on the Public Assistance and Individual Assistance programs for the disaster, with an option to increase that amount to 20% where an optionally enhanced state mitigation plan is in place. The objective of the HMGP is to protect lives and property and significantly reduce or eliminate future disaster expenditures.

Grants for HMGP can be awarded to eligible applicants throughout the state, regardless of the boundaries of the disaster declaration. Eligible applicants include state agencies, local governments, certain private non-profit organizations, and tribes or authorized tribal organizations. Federal funds are typically available for up to 75% (but in some cases up to 90%) of eligible project costs, but *only* for those applicants that have in place or are covered under an approved hazard mitigation plan that meets the requirements of the federal Disaster Mitigation Act of 2000. The remainder of the cost for the project is the responsibility of the applicant.

The HMGP can be used to fund projects to protect either public or private property. Examples of the types of projects that can be funded by HMGP include, but are not limited to:

- Voluntary acquisition or elevation of flood-prone structures.
- Stormwater management projects that reduce flood risk.
- Protective measures for utility infrastructure.
- Vegetation management for dune restoration or wildfire prevention.
- Construction of safe rooms.
- Retrofitting structures for wind protection.
- Development of community hazard mitigation plans (or the update of an existing hazard mitigation plan).
- Project scoping activities to develop cost-effective hazard mitigation projects.

Applicants must apply for HMGP through MSP/EMHSD. The MCCERCC will set priorities for HMGP following a disaster declaration. Based on those priorities, notification of available funding will be made to appropriate entities and organizations. The MCCERCC will review and prioritize eligible applications. Selected formal project applications will then be submitted by MSP/EMHSD to FEMA for final funding approval. A wildfire focused grant is also available, known as HMGP Post Fire.

Pre-Disaster Mitigation Program

The Pre-Disaster Mitigation (PDM) Program provides funding to states and local communities for cost-effective hazard mitigation activities that complement a comprehensive mitigation program and reduce injuries, loss of life, and damage or destruction of property. The PDM Program was authorized by Section 203 of the Stafford Act, as amended by Section 102 of the Disaster Mitigation Act of 2000, and is an annually appropriated, nationally competitive grant program.

States, local communities, and tribes can receive grants for mitigation activities such as planning, and the implementation of projects identified through the evaluation of natural hazards. The FEMA will set priorities for each appropriation of PDM. Annual, nationally competitive application cycles for PDM ended following the fiscal year 2019 application cycle. However, funding of PDM projects has continued through fiscal year 2023 through congressionally directed spending. These mitigation measures are funded on a 75% federal / 25% non-federal basis. Congress is responsible for directing PDM funding to specific projects through the annual federal budget. Once Congress identifies projects for funding, applications for PDM grants are made via the federal E-Grants system. FEMA makes final project approval decisions.

Safeguarding Tomorrow Revolving Loan Fund Program

The Safeguarding Tomorrow Revolving Loan Fund (STRLF) Program was authorized by Section 205 of the Stafford Act, as amended (Pub. L. No. 93-288) (42 USC § 5135) and the Safeguarding Tomorrow through Ongoing Risk Mitigation (STORM) Act (Pub. L. No. 116-284). The STORM Act and its STRLF provides funding for states and tribes to establish a revolving loan fund for issuing long-term, low interest loans to communities and tribes for implementing hazard mitigation measures to reduce risk from natural hazards. Fiscal year 2023 was the first year for the grant program and $50 million was made available nationally. Michigan submitted a grant application which was selected for funding. An additional $450 million is expected to be made available for fiscal years 2024-2027.

Communities will be given an opportunity to submit project proposals annually through an online form. Interested communities with an eligible proposal will then be asked to submit a loan application. The MCCERCC will review and score the applications against pre-established criteria outlined in Michigan's STRLF Intended Use Plan. The program will offer an opportunity for selecting projects that reduce risk but may not be successful in competing for grant funds through FEMA's other HMA programs. The low interest loans will have a maximum 1% interest rate and will be able to be paid of over a 20-year period (30 years for loans issued to low-income areas).

Section 2: Project Prioritization and Selection Process

When selecting approvable projects, each of the programs referenced in Section 1 go through a similar process. Pursuant to Executive Order 2007-18, the MCCERCC is responsible for reviewing, prioritizing, and selecting submitted HMA projects for funding. The MSP/EMHSD and MCCERCC have established specific review criteria and a multi-step process for carrying out that responsibility.

The review process first involves the MCCERCC HMC, which is responsible along with MSP/EMHSD staff for screening solicited applications and potential applicants. A larger selection panel involving additional MSP/EMHSD staff and state agency representatives may also be used when an unusually large number of project applications are received at one time. The MCCERCC HMC reviews and evaluates each eligible application received and then ranks the applications using a numerical system based on prioritized scoring criteria (next page). The committee will evaluate the scoring system prior to reviewing applications to make necessary adjustments for factors such as published annual federal program priorities, program regulation and policy changes, impacts from recent disasters, executive directives, and updated funding strategies adopted by the full MCCERCC Council.

Programs may see prioritization criteria and scoring elements slightly adjusted over time based on multiple factors (e.g., published annual federal program priorities, program regulation, and policy changes, impacts from recent disasters, executive directives, and updated funding strategies adopted by MCCERCC). Regardless of this potential, certain criteria will always be applied to prioritized project funding. The following factors are used for prioritizing funding decisions when evaluating hazard mitigation grant/loan applications:

- The project is identified in the applicable local hazard mitigation plan.
- The project supports the goals and objectives of the MHMP.
- The project meets federal program eligibility criteria.
- The effectiveness of the project in reducing risk.
- The extent to which the project reduces risk.
- The extent to which the project addresses the effects of climate change.
- The community's level of vulnerability from:
    - Natural hazards risk.
    - Environmental risk.
    - Social risk.
    - Development pressures.
    - Population changes.
- Whether or not the project will mitigate damages to repetitive loss properties.
- The number of NFIP insured structures that will be mitigated.
- The project is consistent with the MCCERCC approved strategy for the federally declared disaster (if applicable).
- The project is consistent with other projects, initiatives, and state agency priorities.

Eligibility Criteria

The minimum project eligibility criteria for FEMA HMA grants:

- Conforms with the state, tribal, or local hazard mitigation plan.
- Conforms to environmental, floodplain management, and historic preservation laws and regulations.
- Is feasible to implement and will effectively reduce risk.
- Is cost-effective.
- The project completely or substantially solves a problem independently.
- The project provides a permanent or long-term solution.

Evaluation of Vulnerable Communities

Numerous data tools exist for evaluation of a community's vulnerability based on social inequity and risk from hazards. The available tools are rapidly evolving to become more comprehensive, accurate, and useful. The FEMA and Congress have prescribed the use of several different tools for different HMA programs, frequently employing a Social Vulnerability Index (SVI) such as that used by the Centers for Disease Control and Prevention (CDC). As such, Michigan uses the appropriate online tools or datasets for prioritization purposes in project selection (e.g., CDC SVI, NRI SVI). Many of these tools may be viewed HERE, with additional discussion available in Section 4 of Appendix 2.

Grant Application Scoring

The MCCERCC HMC uses the following prioritization and scoring guide criteria when evaluating HMA grant applications. Criteria may be added, deleted, or adjusted by the committee as necessary to account for federal program priorities, program regulation, and policy changes, impacts from recent disasters, executive directives, and updated funding strategies adopted by the MCCERCC.

Criteria/Points	Description
Risk Reduction/Resiliency Effectiveness (0-35) Point Suggestions: Not at all – 0 Minimally – 7 Partially – 14 Mostly – 21 Entirely – 28 Exceeds – 35	The subapplication details how the project will effectively reduce risk and increase resilience (including the benefits quantified in a Benefit Cost Analysis (BCA)), realize ancillary benefits, and leverage innovation. For example, ancillary benefits could include how this project will reduce carbon emissions, or address inequities, and provide the greatest support to those with the greatest need, or that enable greater community resilience through cybersecurity in accordance with best practices and standards, etc. Additionally, ancillary benefits could include how this project supports the mission areas of Non-Governmental Organizations (NGOs), community-based groups, and other partners. Leveraging innovation could refer to leveraging collaborations and resources with NGOs, community-based groups, and other partners.
Climate Change and Other Future Conditions (0-20) Point Suggestions: Not at all – 0 Minimally – 4 Partially – 8 Mostly – 12 Entirely – 16 Exceeds – 20	The subapplication describes how the project will enhance climate adaptation and resilience, details how the project is being responsive to the effects of climate change (such as sea level rise) and/or other future conditions (population/demographic/land use, etc.), and cites data sources, assumptions, and models.
Implementation Measures (0-15) Point Suggestions: Not at all – 0 Minimally – 3 Partially – 6 Mostly – 9 Entirely – 12 Exceeds – 15	The subapplication adequately describes how the costs and schedule will be managed, how the project will be successfully implemented, and how innovative techniques to facilitate implementation will be incorporated. The project's scope of work identifies sufficient technical and managerial staff and resources to successfully implement this project. The subapplication should describe whether and how the project will incorporate strong labor standards to ensure high-quality work, avert disruptive and costly delays, and promote efficiency. For example, strong labor standards include use of Project Labor Agreements, requiring workers to be paid wages at or above the prevailing rate, use of local hire provisions, using a directly employed workforce (as opposed to a subcontracted workforce), use of an appropriately skilled workforce, e.g., through registered apprenticeships or other joint labor-management training programs that serve all workers, particularly those underrepresented or historically excluded); and use of an appropriately credentialed workforce (i.e., satisfying requirements for appropriate and relevant pre-existing occupational training, certification, and licensure).
Population Impacted (0-25) Point Suggestions: Not at all – 0 Minimally – 5 Partially – 10 Mostly – 15 Entirely – 20 Exceeds – 25	The project subapplication demonstrates community-wide benefits and identifies the proportion of the population that will be impacted, including a description of the disadvantaged communities as referenced in Executive Order 14008. The subapplication also describes how the project was selected and designed to maximize positive impacts and minimize negative impacts to any disadvantaged populations. The subapplication demonstrates how disadvantaged communities as referenced in Executive Order 14008 are benefited.
Community Engagement and Other Outreach Activities (0-5) Point Suggestions: Not at all – 0 Minimally – 1 Partially – 2 Mostly – 3 Entirely – 4 Exceeds – 5	The subapplication describes outreach strategy and supporting activities appropriate to the project and the community that advance mitigation. The subapplication also outlines the types of community planning processes leveraged and describes how input from a diverse range of stakeholders, including overburdened and underserved communities, was gathered and incorporated into project conception and design. Further, the subapplication outlines how such community planning and stakeholder input will continue to be used to help direct project execution.
Leveraging Partners (0-15) Point Suggestions: Not at all – 0 Minimally – 3 Partially – 6 Mostly – 9 Entirely – 12 Exceeds – 15	The project subapplication incorporates partnerships (e.g., state, tribal, private, local community, etc.) that will ensure the project meets community needs, including those of overburdened and underserved populations, and show the outcome of those partnerships (e.g., leveraging resources such as financial, material, and educational resources, coordinating multi-jurisdictional projects, heightened focus on equity related issues, etc.)

Criteria/Points	Description
Does the project address an imminent threat? (Weighted x3) Yes=5 No=0	Consider if the proposed activity will mitigate an imminently dangerous problem that would pose a significant risk to public health and safety if left unresolved. Typically, this would apply for projects where some sort of catastrophic failure will occur within 10 years if unmitigated. Examples may include projects to mitigate dam failure or beach/bank erosion where homes or infrastructure are in peril.
Is the project based on life safety? (Weighted x3) Yes=5 No=0	Consider if the primary intent of the mitigation action to mitigate loss of life or prevent injury?
Does the project mitigate NFIP or FMA repetitive or severe repetitive loss properties? Yes=20 No=0	Staff will review application identified addresses and compare to data in FEMA's Pivot General Support System to score this criterion.
Extent of risk reduction (magnitude and/or longevity) (Weighted x3) (0-5 points)	Consider the useful life of the project and how effectively it will reduce the possibility of future damages. Does the project create long-term benefits and minimize the possibility of residual damages? Possible scoring scale: • Proposed project has a Project Useful Life of 50 years or greater with limited residual damages - 5 points. • Proposed project has a Project Useful Life of 40-49 years with limited residual damages - 4 points. • Proposed project has a Project Useful Life of 30-39 years with limited residual damages - 3 points. • Proposed project has a Project Useful Life of 20-29 years with limited residual damages - 2 points. • Proposed project has a Project Useful Life of 10-19 years with limited residual damages - 1 points. • Proposed project has a Project Useful Life of less than 10 years and/or results in the probability of significant residual damages- 0 points.
Is the project consistent with the goals of the Michigan Hazard Mitigation Plan? (Weighted x2) Not at all – 0 Mostly – 3 Entirely – 5	See Chapter 7 of the plan for a summary of these goals.
The subapplicant has poor past performance. (Weighted x2) No=5 Yes=0	The subapplication will receive 5 points if the subapplicant has never: • Been found to have violated grant rules or regulations on a prior approved FEMA HMA grant. • Underperformed on a prior approved FEMA HMA grant, resulting in the deobligation and return of 50% or more of the federal funds. Canceled a prior approved FEMA HMA grant resulting in the return of all federal funds.
What is the quality of the application? (0-5, weighted x2) Not at all – 0 Minimally – 1 Partially – 2 Mostly – 3 Entirely – 4 Exceeds – 5	The application and attachments outline a quality scope, schedule, budget, and BCA. • Scope of work is clear and detailed. It identifies tasks, methods, materials, and equipment required. The location, size and dimensions are clear. It outlines who will perform the work, how the project will function, provides assurance that the project is technically feasible and explains why this is the best alternative. • The proposed schedule is clear and realistic, with a breakdown of activities and milestones to demonstrate the ability to complete the work within the established timeframe. • The budget is itemized and includes a detailed breakdown of all costs associated with the proposed activity. It mirrors the scope of work and schedule. Costs are eligible and reasonable, and documentation provided. • A BCA is included using FEMA BCA software, has a positive result, relevant supporting documentation provided, and appears to be cost effective (or an approved pre-determined benefit method is explained). • The environmental considerations section of the application is completed, areas of environment concerns are addressed, and the project appears to be environmentally sound. Appropriate attachments are included, such as engineering and design plans, budget narrative, elevation certificates, property appraisals, etc.
Is the project identified in the local mitigation plan? (0-5, Weighted x1)	• The specific project is identified as a needed mitigation action – 5 points. • The project is not identified but the type of activity is identified as a strategy to mitigate a local vulnerability – 3 points. • Neither the project nor the type of activity is identified – 0 points.

Criteria/Points	Description
The subapplicant has never received a mitigation grant in the past. (Weighted x1) No=5 Yes=0	Five points will be awarded to communities who have never applied or have never been successful in applying for an HMA grant to provide added incentive to pursue HMA grants.

RESPONSE KEY:

Not at all	The subapplication does not address the criterion at all.
Minimally	The subapplication addresses the criterion, but information in the subapplication may be confusing, unclear, and/or incorrect. The degree to which the subaplication demonstrates the criterion is minimal, and references to the criterion don include substantive information.
Partially	support, have some minor inconsistencies, or not address all components of the criterion. The degree to
Mostly	Although the subapplication may include a few minor inconsistencies or areas that need more clarity, there is strong support for most components of the criterion. The degree to which the subapplication demonstrates the criterion has been met is acceptable.
Entirely	The subapplication is clear, concise, and complete, provides examples, and is supported by data. It addresses all components of the criterion and may have a particularly compelling narrative. The degree to which the subapplication demonstrates the criterion has been met is excellent.
Exceeds	In addition to addressing all components of the criterion, being clear concise, complete, and supported by data, the subapplication articulates the impact of the project in catalyzing broader efforts (such as legislative action or project type awareness) as they relate to the criterion. The degree to which the subapplication demonstrate the criterion has been met is beyond excellent.

Based on the scored project rankings, and as limited by the amount of federal funding available, the recommended project applications are then presented before the full MCCERCC Council for concurrence. Which projects will ultimately receive funding varies based on the type of HMA program.

States have more control with directing HMGP funding, with FEMA generally allowing the state to determine project selection. There is also more flexibility with HMGP funding, and the MCCERCC may choose to establish special priorities for certain types of projects as most appropriate for a specific disaster. For example, the acquisition of flood-prone structures, or projects that mitigate for repetitive loss properties, could be deemed as the highest priorities. The establishment of any special funding priority is set forth in a mitigation strategy jointly developed with FEMA.

For nationally competitive BRIC and FMA funding, the prioritized project application listing is submitted by MSP/EMHSD to FEMA for consideration. Once project applications enter the federal review process there is no guarantee that the state's highest ranked applications will actually be selected for funding under BRIC or FMA. In some cases, lower priority projects may be selected because the national review committee granted them higher scores. Beyond any minimum amount that may be set by FEMA as authorized for each state, it is possible that no additional projects will be selected for Michigan due to the competitive nature of the programs.

Section 3: Other FEMA Programs and Grants

Other select FEMA programs and grants with a nexus to mitigation planning include the following:

Fire Management Assistance Grant Program

The Fire Management Assistance Grant (FMAG) Program is available to local, state, and tribal governments for the mitigation, management, and control of fires on publicly or privately owned forests or grasslands (which threaten destruction at a level that would constitute a major disaster). The process is initiated when a state submits a request for assistance to the FEMA Regional Director at the time a "threat of major disaster" exists. Before a grant can be awarded, a state must demonstrate that total eligible costs for the declared fire meet or exceed either the individual fire cost threshold, which is applied to a single fire, or the cumulative fire cost threshold, which recognizes numerous fires. Achieving standing program eligibility for a state is optional, and Michigan is reviewing the program and its requirements. Because there has never been an FMAG declaration within FEMA Region 5, in part because the program is intended for disastrous wildfires where a high damage threshold can be met, there is not currently a strong opportunity for Michigan as a state to use the program.

High Hazard Potential Dams Grant Program

The HHPD Grant Program is not administered by MSP/EMHSD and is detailed separately under dam related materials available in Appendix 8. While this program is optional for the state, it has been successfully used in the past and the MHMP is currently HHPD compliant.

Homeland Security Grant Program
The Homeland Security Grant Program (HSGP) includes a suite of risk-based grants to assist state, local, tribal, and territorial efforts in preventing, protecting against, mitigating, responding to, and recovering from acts of terrorism and other threats. This grant provides grantees with the resources required for implementation of the National Preparedness System and working toward the National Preparedness Goal of a secure and resilient nation. While these grants are typically thought of as "preparedness" grants, they may still sometimes selectively apply to mitigation activities.

National Flood Insurance Program and Risk Mapping, Assessment, and Planning Processes
The FEMA is responsible for providing the regulatory tools of the previously mentioned NFIP, which makes flood insurance available to communities that have agreed to manage their floodplains in a manner geared towards minimizing future losses from flood damage. The NFIP is delivered directly by FEMA or through a network of companies who can write a policy under their own name (with FEMA still underwriting losses). FEMA provides information on how homeowners can understand flood zones and maps to help them decide if flood insurance is right for them. Risk Mapping, Assessment, and Planning (Risk MAP) is how FEMA describes the process they use in determining flood risk. See Appendix 5 for more information.

Section 4: Other State Programs, Regulations, and Initiatives

Michigan has several other hazard specific regulations, programs, and initiatives that are specifically detailed in the MHA, arranged by hazard type. The MHA is considered as an attachment to this publication, and those regulations and initiatives are in general not duplicated here.

Exceptions have been made for the NFIP so that the MHMP can meet additional FEMA requirements as it relates to repetitive loss and severe repetitive loss structures. See Appendix 5 for more information. The separate Catalyst Communities Initiative is a collaboration between EGLE and other state departments to provide training and technical assistance to local governments as they work towards sustainability goals, often as linked to climate change. Some of the program's adaptation efforts align with and may be alternatively described as hazard mitigation.

The MSP/EMHSD has a Public Private Partnership (P3) program that collaborates with Michigan (and national) companies as it broadens the base of stakeholders combatting hazards. Although many of the program's contributions are most evident in the response and recovery phases of emergency management, some preparedness activities that increase community resilience have a nexus in mitigation. Other efforts include education, training, and weather alerts. A strong aspect of the P3 program includes partnerships with several organizations in the energy sector and the hosting of Local Energy Assurance Planning workshops throughout the state.

Michigan's overall Emergency Management Program uses planning grants, sometimes referred to as Capability and Capacity Building (C&CB) grants, to specifically assist local governments with the creation of their own hazard mitigation programs. While planning grants are often accomplished through the select HMA programs already discussed in Section 1 of this chapter, MSP/EMHSD's technical assistance and programmatic capabilities as they relate to local hazard mitigation plans are discussed more fully in Chapter 6. Materials specifically related to land use laws (zoning) and building code enforcement at the local level are separately found in Appendix 6.

Chapter 6: Local Hazard Mitigation Planning

Local emergency management programs vary in the amount of staff and resources they can dedicate to hazard mitigation planning. The MSP/EMHSD provides technical expertise, training, and review for local hazard mitigation plans, taking a partnership approach with these important stakeholders.

Section 1: The Role of Local Planning

Just as response efforts begin at the local level, so does mitigation. Some local governments and programs have dedicated planning departments or mitigation specialists while others hire external assistance to meet planning requirements on an as-needed basis. This is largely driven by the tax base for the area and resource availability. Some lower population areas may have part time emergency management coordinators or share them across counties. The amount of resources available to other county agencies (such as road commissions and drain commissions) likewise differs throughout the state.

Land use policies for the state are distinctly local and can be an effective means of achieving hazard mitigation (see Appendix 6). Most of the land use and development mechanisms available to implement hazard mitigation measures are also applied at the local level. Successful implementation of a program to reduce Michigan's vulnerability to hazards will therefore be a joint cooperative effort between the State, local governments, and associated stakeholders.

Given national, regional, state, and local planning levels, local capabilities have practical limits as to what type of planning is authorized or appropriate to pursue. Additional political constraints may also exist. In circumstances where local plans are largely reflective of past initiatives, they may be designed to primarily preserve the policies that originally attracted people to a community. Change may be slow. In other communities, a plan might be more aggressive in promoting hazard related initiatives that are demonstrably justified. Despite these different approaches and varied levels of resources, all hazard mitigation plans are assessed according to the same FEMA standards. Smaller communities or those more content with the status quo might find mitigation planning requirement more difficult to achieve. Rural communities in particular may have greater problems accessing grants, finding non-federal matching funds, and dealing with the administrative requirements of pursuing hazard mitigation.

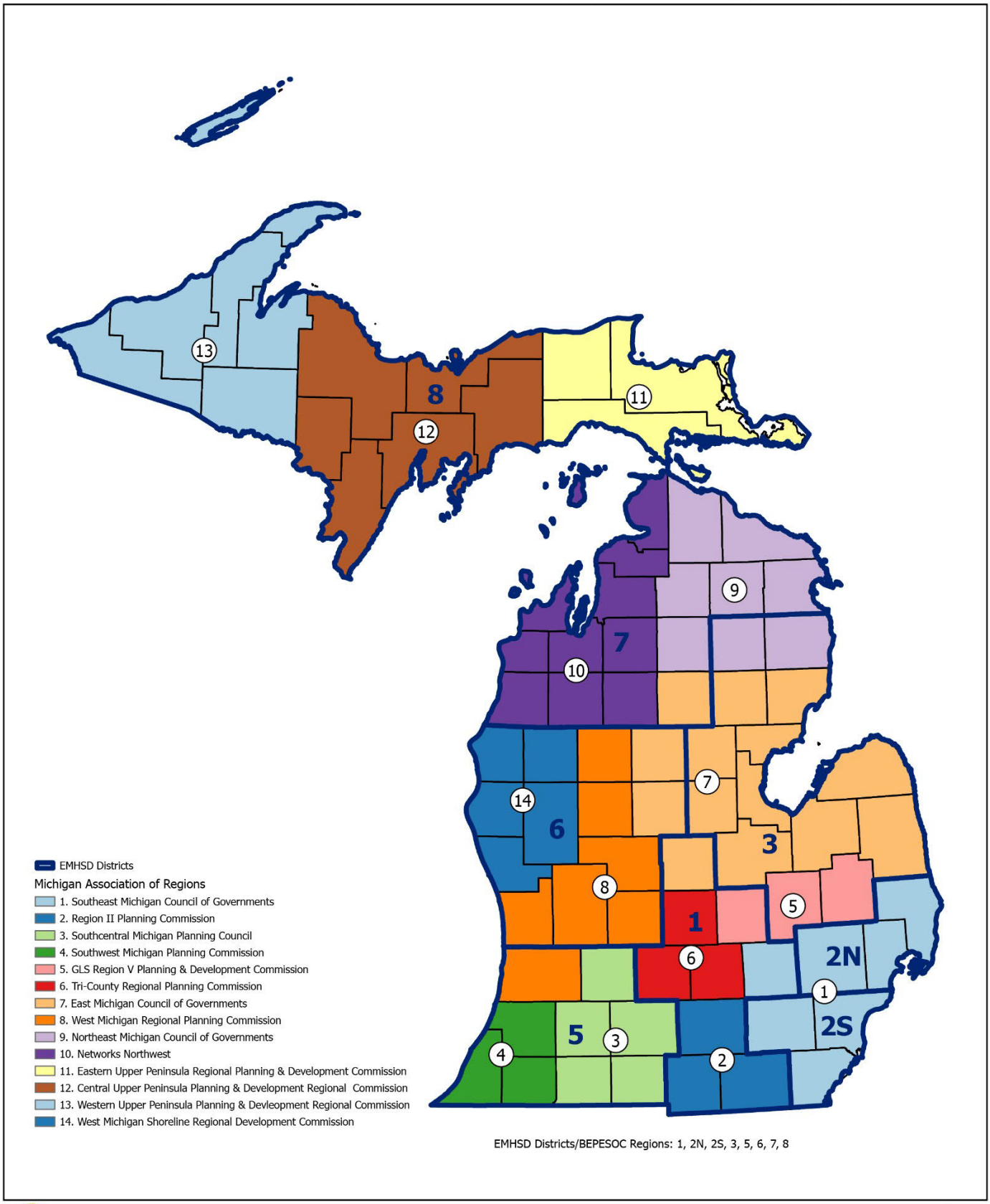
As a partial solution, local governments frequently collaborate with Michigan's non-profit regional planning agencies in order to augment their capabilities. The Michigan Association of Regions is divided into fourteen regions, which have been overlayed with the eight MSP/EMHSD District Coordinator regions on a map on the following page. These eight regions are also used by the Bureau of Emergency Preparedness, EMS, and Systems of Care (BEPESOC).

The nature of these planning organizations can be quite different, impacted by many factors depending on where they are situated and the communities that make up their regions. For example, although many resources exist within the general Metro Detroit area, the complexity of the region goes beyond that for which any one agency can completely cover. The municipalities and counties that compose the region also do not have the authority to speak on behalf of the entire metropolitan area. For this reason, the Southeast Michigan Council of Governments (SEMCOG) planning office for example tends to act within limited spheres of coordination and technical assistance, as practical and politically feasible, while still providing expertise and perspectives that successfully aid in positively impacting planning decisions for the region.

The best-quality organizations and firms assisting local governments do good work, but there still remains an enormous array of steps and tasks for local stakeholders to account for and conduct. Capabilities can additionally be restrained if the greater community does not have the time or interest to fully participate in the multiple processes that hazard mitigation plans frequently call for. It is for these reasons that while local capabilities can often be enhanced by these professional organizations that they should not be viewed as a panacea.

Other factors affecting local capabilities are discussed in Appendix 7, including a review of the predominant hazards and mitigation related strategies that vary for local governments based on their unique risks and vulnerabilities.

MICHIGAN ASSOCIATION OF REGIONS
OVERLAYED AGAINST EMHSD DISTRICTS/BEPESOC REGIONS



Section 2: Local Hazard Mitigation Plan Support and Status

The MSP/EMHSD supports the development of local hazard mitigation plans through providing outreach activities, training, technical assistance, and the review of mitigation plans in order to assist local governments in complying with FEMA requirements. Select details on these activities as they have taken place from between when the 2019 MHMP was first published and through the planning process for this 2024 MHMP are available in Appendix 7.

Support is also provided through the funding of local hazard mitigation plan development via HMA programs. The MSP/EMHSD has historically taken full advantage of these federal planning provisions, such as in December 2001 when it allocated 7% of available HMGP funds (as a result of Federal Disaster 1346) to support the development of hazard mitigation plans in emergency management program jurisdictions across Michigan (all 83 counties plus selected municipalities over 10,000 in population). Annual PDM funds allowed for the development of additional plans, primarily in the more densely populated areas of southern Lower Michigan, beginning in 2002. The FMA Program was also employed, but by 2008 was only allowed to be used on the flood portions of mitigation plans.

Since 2019, PDM has effectively been replaced by the new BRIC program when it comes to providing funds for local hazard mitigation plans. The HMGP also makes funds available after a federally declared disaster. It should be noted that planning related projects are now frequently referred to by FEMA as being part of C&CB related activities and grants.

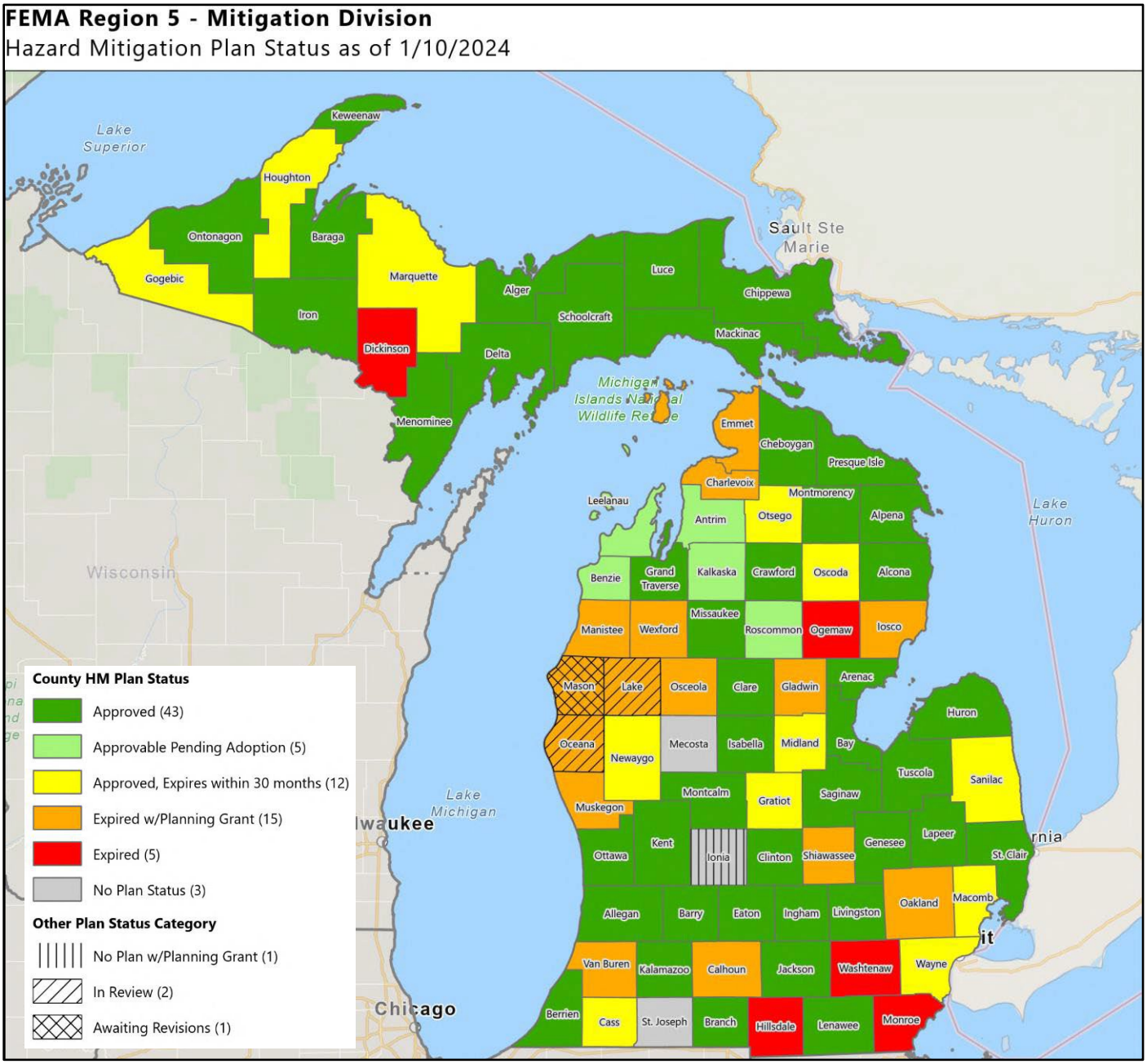
Through these support initiatives, the vast majority of Michigan counties have been able to complete an approved hazard mitigation plan in the past. Most have gone through multiple update processes since their original plans were approved. As of late 2023, there are just three remaining Michigan counties that have never received an approved hazard mitigation plan: Ionia, Mecosta, and St. Joseph Counties. It should be noted that the City of Ionia itself has had an approved plan.

All three of these counties are at various stages in pursuing a plan at the time of this writing. As of December 2023, it is anticipated that St. Joseph County in particular will be submitting a plan for approval in 2024. Ionia County successfully received a planning grant under PDM in fiscal year 2019 and is also expected to complete a 2024 plan. Mecosta County has started draft plans in the past and is attempting to build off of these prior efforts by pursuing other local planning milestones as it attempts to secure necessary plan funding.

Since the start of 2019, the following counties or local/tribal jurisdictions have been covered by hazard mitigation plans (or plan updates) in Michigan: Alcona County (3/21/22), Alger County (12/19/22), Allegan County (11/1/21), Alpena County (1/7/22), City of Ann Arbor (12/7/22), Arenac County (4/4/23), Baraga County (1/24/22), Barry County (6/9/23), Bay County (3/21/22), Berrien County (3/20/23), Branch County (7/19/23), Cass County (3/7/19), Cheboygan County (7/19/23), Chippewa County (8/18/21), Clare County (6/1/23), Clinton County (8/24/23), Crawford County (1/24/22), Delta County (2/1/23), the City of Detroit (3/17/22), Eaton County (4/4/23), the City of Farmington Hills (9/1/22), Genesee County (5/5/22), Gogebic County (6/15/21), Grand Traverse County (9/28/22), Gratiot County (7/16/20), Houghton County (6/17/20), Huron County (3/30/22), Ingham County (8/25/23), Iron County (11/14/22), Isabella County (1/26/23), Jackson County (10/5/22), Kalamazoo County (7/5/23), Kent County (5/5/23), Keweenaw Bay Indian Community, Keweenaw County (8/12/22), the City of Lansing (1/30/19), Lapeer County (4/14/22), Lenawee County (8/25/23), Livingston County (4/4/22), Luce County (8/18/21), Mackinac County (3/2/22), Macomb County (4/26/21), Marquette County (1/25/21), Menominee County (3/7/23), Michigan Technological University, Midland County (1/28/19, later amended to include High Hazard-Potential Dams risk and project information), Missaukee County (11/9/23), Montcalm County, Montmorency County (2/10/22), Newaygo County (6/9/21), Oakland County (9/5/18), Ontonagon County (8/12/22), Oscoda County (7/21/21), Otsego County (6/1/21), Ottawa County (8/25/23), Pokagon Band Reservation (10/26/23), Presque Isle County (3/7/23), Saginaw County (6/1/23), Sanilac County (10/21/20), Schoolcraft County (3/7/23), St. Clain County (9/15/22), Texas Township (in Kalamazoo County), Tuscola County (10/13/22), the University of Michigan (Ann Arbor, Flint, and Dearborn campuses, 10/31/19), and Wayne County (5/11/21). Although not yet approved by FEMA, an MSP/EMHSD review for the Hillsdale County plan was also completed in April 2020 and feedback was sent to the county's planning staff.

As of late November 2023, some additional plans had passed FEMA review but had not been adopted at the local level (Antrim County, Montcalm County, Roscommon County). As the status map on the following page is revised it will indicate if these plans have subsequently become fully approved. Other plans had been received but were still under review (Benzie County, Kalkaska County, Lake County, Leelanau County, Mason County, Oceana County, and for the Grand Traverse Band of Ottawa and Chippewa Indians). Technical assistance provided after this date includes for the Little Band of Ottawa Indians (January 2024) and Michigan Technological University (February 2024). A submission by Oakland County was considered imminent.

Maps showing county status are compiled by FEMA and provided to MSP/EMHSD as changes are made. The maps are updated several times a year but may include slight lags in data as plans are processed. The most recent map available as of January 10, 2024 is included, but it is expected that many changes will occur throughout the year.

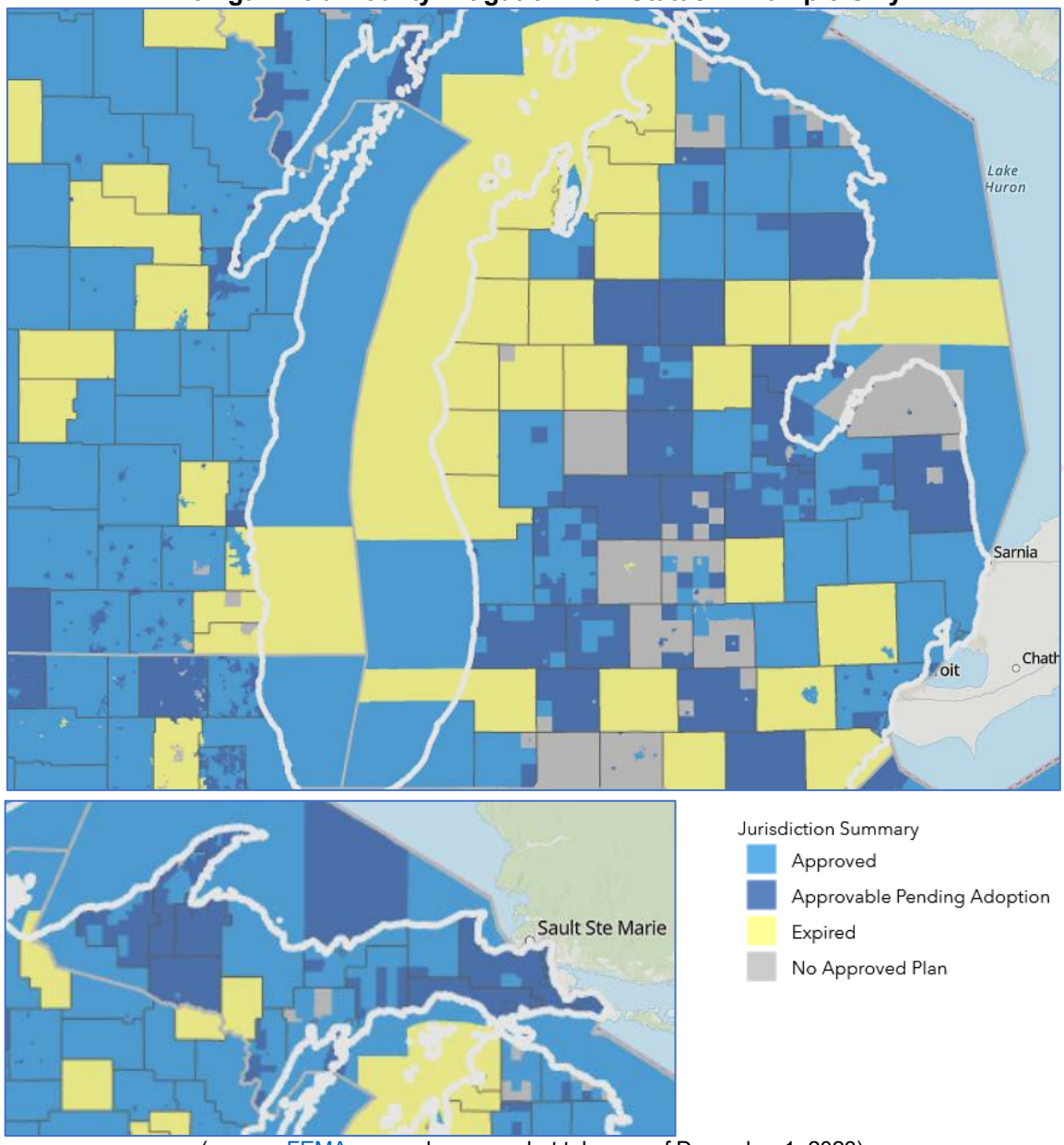


(source: FEMA)

Readers seeking more granular information can also visit FEMA's hazard mitigation plan status website in order to view which jurisdictions within a county have participated in their county's planning process (and have subsequently adopted the approved county plan at the local level).

While a representative map for this website is shown on the next page, it is provided only as an example of available information. Data is changed frequently and adjusted as plan status changes, with MSP/EMHSD staff and FEMA collaborating when edits need to be made. Because the web-based map (next page) is intended to highlight the status of jurisdictions within counties, and not the counties themselves, readers should use caution when interpreting the information. If several intra-county jurisdictions have not officially adopted an approved county plan it may inadvertently appear that the county itself has an expired plan.

Michigan Intra-County Mitigation Plan Status – Example Only



(source: FEMA; example screenshot taken as of December 1, 2023)

Section 3: Local Hazard Mitigation Plan Processes

Local hazard mitigation plans in Michigan are first submitted to MSP/EMHSD for initial review, and once successfully completed are then required by FEMA to be submitted to their Region 5 office in Chicago for federal review. The State's role in the process is designated primarily as an advisory one, as a means of supporting/completing local planning activities and assisting with federal review. Only the FEMA review of a plan is considered official for FEMA purposes (making communities eligible to receive or directly benefit from applicable hazard mitigation project funds). Tribal plans may alternatively skip any review process with the state and work directly with FEMA.

Planning staff from MSP/EMHSD employ their own review form, consistent with FEMA's current plan review tool but containing more explanatory detail. When review criteria are met, the plans are forwarded to FEMA with the recommendation that they be approved. Such submissions are accompanied by documentation that the plan, in the judgment of the reviewer, met the local planning requirements of the Disaster Mitigation Act of 2000. If one or more review items is deemed inadequate, a completed copy of the plan review form is returned to the community to convey the elements for which the plan's quality or content needs enhancement. Comments or suggestions are included in reviews, describing corrections, additions, or deletions that the reviewer believes to be necessary for official approval, plus any other recommendations the reviewer believes would help to improve the quality of the plan without undue burden. The MSP/EMHSD staff thus work with communities and coordinate with FEMA as needed until the plans meet all the required elements and are officially approved by a federal review.

Because approved plans are valid for five years, a great deal of work needs to be done on an ongoing basis in order to keep local hazard mitigation plans updated and current. Sometimes, fewer funds are available through programs such as HMGP (i.e., during periods when Michigan has fewer disaster declarations), and therefore an alternative means of plan update has to be considered and utilized. Although there are currently sufficient HMGP funds available to Michigan, this challenge may also apply to communities for whom the use of grant money has not seemed to be economically feasible or politically desirable (since the funds tend to require a 25% non-federal match component and staff time to handle a grant's application and administrative requirements). In the few cases where direct MSP/EMHSD assistance has recently been used, the following descriptions provide an overview of such a process:

1. Because the basis for a mitigation plan is its hazard analysis, available staff considered all convenient sources of hazard information, considering the strengths and weaknesses of alternative sources.
2. The most readily available information sources were used to provide locally specific information that was incorporated into community hazard mitigation plans, emphasizing procedures that did not require special expertise or funded assistance to complete.
3. The MSP/EMHSD staff determined the amount of direct assistance that it could provide to local planning efforts.
4. The MSP/EMHSD staff inquired and determined which communities had a greater need for assistance, and how assistance would be prioritized among multiple communities that had simultaneous competing needs for it.
5. The MSP/EMHSD staff met or were in contact with local emergency managers as needed (e.g., scheduled custom meetings, regular phone calls, and emails, attendance at MSP district coordinator meetings that occur regularly in multiple locations) and presented ideas for plan development and direct assistance procedures to the local emergency managers and MSP/EMHSD District Coordinators.
6. Direct assistance with plan updates has included editing obtained information into a document that was judged to be able to pass FEMA plan review procedures. The process accounted for mutually developed priorities.

The MHMP is based on a framework that is informed by risk (see Chapter 7), as summarized by the ranked and prioritized hazards in this plan (Chapter 4). Potential projects are also ranked by prioritized criteria that is represented in project scorecards (Chapter 5). Resources are directed by these prioritizations and can drive local support decisions where warranted. Additional processes are therefore not typically necessary for determining where support should be provided. When it has been necessary (due to situations such as staffing shortages) the following criteria have been used:

1. Communities that had specific projects they had arranged to fund through the HMA program were prioritized over those that did not have specific project ideas. The rationale for this is that HMA assistance requires a completed or updated local hazard mitigation plan to be in place and approved by FEMA. Communities with fewer immediate needs for federal mitigation funding would be expected not to suffer as much from any lapse that may occur in keeping their local plan up to date.
2. Communities with an active local emergency manager, who had a means by which the required local input/review process could take place for a plan, were prioritized over those that did not. The rationale for this is that MSP/EMHSD planning staff could provide only so much direct planning assistance, but not the full local coordination that is required to bring a local plan to completion and get it adopted by local authorities. Therefore, it made sense to favor the provision of assistance to communities who could supplement it with their own efforts, without which a plan cannot be successfully completed. MSP/EMHSD work *alone* could not cause a local plan to be successfully completed or updated. The update process goes beyond the mere revision of a planning document, and also requires a local review and input process to guide and use information from an updated local hazard analysis (and put it to work in updating a set of *local* hazard mitigation strategies to be implemented as a result of the plan).
3. Communities that had more pressing needs, based either on their history of emergency and disaster events or based on the extent of vulnerabilities revealed by their local hazard analyses, were prioritized. The rationale for this is that areas more vulnerable to damage or loss of life had more potential gains to be realized from efforts invested in hazard mitigation activities.
4. Communities that had fewer alternative means of completing their hazard mitigation plans were prioritized for direct planning assistance by MSP/EMHSD planning staff. The rationale for this is that limited MSP/EMHSD staff time was best served for those programs with diminished capacities (e.g., overwhelmed by a local disaster, new emergency managers, part-time emergency managers, not located in regions well-served by county/regional/university planning resources). This was sometimes reflected in programs whose prior attempts to procure planning grants had been unsuccessful.

Chapter 7: Mitigation Strategy

Michigan's mitigation strategy for the MHMP is set on a foundation of guiding principles. These and further mitigation tenets are provided here, with details evidenced in the criteria for the project selection process previously laid out under Chapter 5. General principles and tenets are discussed below, eventually leading to the 2024 Action Plan that is a core end product for the MHMP.

Section 1: Guiding Principles and Tenets

The overarching guiding principles as laid out by FEMA for state mitigation plans include:

- A focus on risk-informed mitigation strategies.
- The fostering of cooperative relationships and integrated planning frameworks between state and local plans.
- Steps towards improved state mitigation capabilities.

Some other general tenets utilized by MSP/EMHSD in the MHMP include:

- Non-structural measures are being considered along with structural measures.
- Voluntary measures emphasized over mandatory measures.
- Education-based compliance and cooperation emphasized over legislated mandates.
- The least expensive alternative, in general, is emphasized over more expensive ones.

It should be noted however that more expensive alternatives may be selected when they are expected to yield greater long-term social, environmental, and economic benefits.

As specific to the development and implementation of flood related hazard mitigation recommendations:

- The NFIP-participating communities will have priority over non-participating communities.
- Communities and sites suffering repetitive losses will receive greater emphasis.
- Flood mitigation projects will tend to be implemented in the following order of priority:
    1. Acquisition and relocation of flood-prone structures.
    2. Elevation of flood-prone structures.
    3. Stormwater management/improvement projects.
    4. Drainage projects (e.g., culverts, channels, retention ponds, detention ponds).
    5. Wet and dry flood proofing of structures.
    6. Structural measures (e.g., floodwalls, dikes, jetties).

Section 2: Overarching Mitigation Strategy and Goals

Michigan's overarching mitigation strategy involves the execution of the following core MSP/EMHSD mitigation capabilities:

- Projects grants, as described under Chapter 5 (e.g., HMA, HHPD).
- The C&CB grants (e.g., hazard mitigation planning, scoping, building codes, and partnership activities).
- The provision of technical expertise, training, and review for local hazard mitigation plans (or for general educational purposes to a broad array of community partners).

Specific tenets associated with this overarching mitigation strategy are expressed via the prioritized criteria used in the project selection process as described in Chapter 5.

Other strategies and/or capabilities may be used, especially as they relate to specific emergency declarations and their unique hazards, locations, and impacts. Such additional strategies may be done in conjunction with FEMA, MCCERCC, and other applicable stakeholders.

The MHMP has established an Action Plan (Section 4, below) that uses state capabilities to address the risks and vulnerabilities as identified and prioritized throughout this plan. These have resulted in a list of specific mitigation objectives for the 2024 MHMP that are discussed further below. The objectives have been grouped into the following four broad thematic goals:

Goal #1: Prioritize Life Safety
Goal #2: Reduce Property Damage
Goal #3: Collaborate With and Increase Stakeholder Knowledge
Goal #4: Execute Mitigation Related Programs and Administrative Duties

Section 3: Mitigation Objectives and Selection Process

The mitigation objectives included in the Action Plan were informed by the various information and conclusions contained in the publications, chapters, and appendices associated with this plan. While all aspects of the MHMP are important, many parts of the plan attempt to summarize their key information. Readers looking to quickly find these summaries should especially refer to: Chapter 4 (Section 3, Combined Hazard Analysis and Summation) and Chapter 5 (Section 2, Project Selection Process and Prioritization), as well as specialized information in Appendix 2 (population), Appendix 3 (climate), and Appendix 7 (local hazards). These parts of the plan helped to inform the mitigation objective selection process so that objectives are risk informed, linked to local mitigation strategies, and consider the priorities used in the project selection process.

Preliminary mitigation objectives were based on a process that began by referring to the objectives included in the 2019 MHMP. Those objectives and their evaluation were an early part of the planning process for the 2024 MHMP, with several meetings being held with various state agencies, MSP/EMHSD personnel, and a variety of other stakeholders (see Appendix 1). Based on these meetings, the State Planner tasked with the primary responsibility for producing this publication created a preliminary objective list for the 2024 MHMP that was refined over the course of several months based on subsequent meetings, as well as (1) information gleaned from the MHA, (2) new and ongoing disaster declarations, (3) new FEMA guidance, and (4) various other components of this plan as they were completed. The MCCERCC HMC was also part of this iterative process, providing input and guidance as the objectives and action items were further refined. After the list neared preliminary finalization, it was presented to FEMA in draft form for comment, with changes made. The objectives were then again presented to the MCCERCC HMC, which discussed and accepted them in anticipation of their presentation before the full MCCERCC Council.

In a parallel fashion, the State Planner had also been attending ongoing public meetings of the full MCCERCC Council, making an open request for any suggestions, and informing the council that draft mitigation objectives would be provided to them in the future. The Chair of the MMCERCC HMC and the State Planner then later presented the objectives to the council at a full MCCERCC meeting. The objectives were formally approved as part of an official vote by the MCCERCC, and the plan was submitted to FEMA as part of the Approved Pending Adoption (APA) process.

Section 4: Action Plan

The following Action Plan is primarily organized by placing mitigation objectives into the categories of four broad programmatic goals. In many cases, an argument can be made that a particular objective could be associated with a different goal or even multiple goals. While these potential synergies are welcome, the Action Plan still places objectives with the goal it seems primarily best suited to.

The Action Plan also includes information related to the primary hazard(s) that specific mitigation actions are attempting to influence. It was discussed that some objectives and actions addressed more than one, or even many hazards. Multiple hazards are therefore provided for most objectives depending on how strong their nexus is. In some cases, “All Hazards” is listed, and is meant to convey that the objective/action largely applies to almost all natural hazards, as well as many of their primary interfaces with technological or human-related hazards. This was particularly the case for educational or training related objectives, which tend to focus on a broad array of risks that address multiple hazards.

Some hazards may also be attributed to “All Hazards (Grant Eligible)”, where the grant being used may restrict the hazards they can be applied to. Generic references to “Climate Related Hazards”, as used in the context of the Action Plan, are meant to mean all hazards that have an obvious nexus to impacts amplified by the effects of climate change.

Other important caveats appear after the Action Plan listing, which begins on the next page. Ultimately, the provided objectives should be viewed as specific, highlighted components as part of the MHMP’s planning processes, goals, and overall mitigation strategy.

Objectives are tied to their primary goals and sequentially numbered, potentially carrying more than one implementation action. As an example, a reference to Objective 1.2(b) would indicate Goal 1, Objective 2, Action (b). The target date column indicates the estimated completion time for the action, where a reference to "ONG" indicates an ongoing action that is anticipated to be attempted on a continual annual basis.

ACTION PLAN

GOAL 1: Prioritize Life Safety

Objective	Target Date	GOAL 1: Prioritize Life Safety Objective / Implementation Action	Primary Hazards Addressed
1.1		Resilient health and safety in the face of climate change, including in anticipation of an increased frequency of extreme heat.	
	2024	*a. Conduct a series of trainings for local health departments (LHDs) to broadly cover how to integrate climate adaptation into their essential public health functions. Targeting three webinars for 2024 with intent for representation from all LHDs.*	Public Health Emergencies
	2028	*b. Leverage the Michigan Climate and Health Adaptation Planning Guide by having state government partner with the local governmental members of Michigan Green Communities. Collaboration will include training (three webinars and two in person workshops) that will lead to facilitated mitigation measures for at least two communities over the next four years.*	Flooding, Climate Related Hazards
	2025	*c. Finalize/garner funding to create resilience hub(s), initially to be established in eastern Detroit. Attempt roll out to other communities as funding allows. This will be done in conjunction with an initiative to better understand the risk factors for heat and cold illness, evaluate the syndromic surveillance system for heat and cold, and develop strategies for improved planning and use of shelters/resilience hubs.*	Extreme Heat, Extreme Cold, Power Outages, High Winds, Tornadoes
	2024	*d. Expand state administered and collaborative urban forestry opportunities to accelerate urban tree/wood lifecycle stewardship and associated mitigation benefits. After expansion, target of at least four community engagement events annually, designed to spur initiatives related to climate adaptation and urban wood utilization.*	Extreme Heat, Power Outages, Invasive Species
1.2		Promote and develop public alert and early warning capabilities as part of integrated safety systems (including safe room facilities).	
	2024	*a. Achieve statewide coverage for the Integrated Public Alert and Warning System (IPAWS) in all counties.*	High Winds, Tornadoes, All Hazards
	2025	*b. Pursue pilot project for "Giant Voice"/mulithazard alert systems on state park or similar properties, with or without accompanying "safe room" shelters.*	Lightning, Hail, High Winds, Tornadoes, Great Lakes Shoreline, Terrorism and Similar Incidents
1.3		Mitigate the risk and consequences of dam failure through the assessment, review, and updating of high hazard potential dams (HHPD) and associated maps, plans, and programs.	
	2026	*a. The EGLE will ensure an Emergency Action Plan (EAP) for all HHPD have been reviewed and updated at least every three years (and made part of such an ongoing EAP review cycle).*	Flooding, Dam and Levee Failures
	2025	*b. The EGLE will work towards creating inundation maps for all HHPD in the state, with the intention of making inundation boundaries available to the public for use in local planning and educational efforts.*	Flooding, Dam and Levee Failures
	ONG	*c. The EGLE will collaborate with MSP/EMHSD in identifying dams eligible under the HHPD Grant Program so that applicable jurisdictions can be encouraged to make local mitigation plans HHPD Grant Program compliant.*	Flooding, Dam and Levee Failures

Objective	Target Date	GOAL 1: Prioritize Life Safety Objective / Implementation Action	Primary Hazards Addressed
1.4		Provide the owners and operators of Critical Infrastructure/Key Resources (CIKR) with data so that they and other stakeholders can take appropriate mitigative measures.	
	ONG	*a. Provide Physical Security Assessments to CIKR owners and operators, with a target of completing 12-18 assessments annually through the Michigan Intelligence Operations Center (MIOC) and other partners.*	Terrorism and Similar Criminal Activities
	2025	*b. Track electric power grid reliability by having utilities report granular data to the Michigan Public Service Commission (MPSC), with the intent of mapping such data and placing it on a public facing website so that utilities, emergency managers, and planners can better identify historically problematic areas and take appropriate mitigation measures to reduce future outages.*	Power Outages
	2025	*c. Continue to identify and define CIKR across the state in order to analyze interdependencies that can create worst case event scenarios, using the information to increase the resiliency of such assets. Three reports will be created as part of the Michigan Infrastructure Prioritization Project.*	All Hazards

GOAL 2: Reduce Property Damage

Objective	Target Date	GOAL 2: Reduce Property Damage Objective / Implementation Action	Primary Hazards Addressed
2.1		Acquire/remove, relocate, or elevate structures that currently occupy floodplains or that have otherwise suffered from repetitive flood losses.	
	ONG	*a. Identify structures that have suffered from repetitive flood loss.*	Flooding
	ONG	*b. Assist in the acquiring/removing, relocation, or elevation of at-risk structures where feasible.*	Flooding
2.2		Position the state to take proactive climate related mitigation measures prior to facing significant property loss.	
	2025	*a. Fully integrate Michigan into the Drought Early Warning System (DEWS), part of the National Integrated Drought Information System (NIDIS), by becoming an official contributor to the Midwest Network and participant in the Midwest DEWS Strategic Action Plan (2025).*	Drought
	2024	*b. Finalize criteria for use of an invasive species Immediate Response Fund, to begin availability in 2024 to address a founding population, newly discovered watch list population, or high threat invasive species.*	Invasive Species
	2024	*c. Adopt a Tribal-State Manoomin/Mnomen Stewardship Plan as a continuation of the Michigan Wild Rice Initiative to ensure measures are taken to mitigate against the potential impacts of climate change on culturally important species.*	Climate Related Hazards
2.3		Assist local communities and fire departments with education efforts, wildfire planning, and mitigation projects statewide.	
	ONG	*a. Assist and make use of grants from the Forest Service of the US Dept. of Agriculture to help fund communities developing Community Wildfire Protection Plans (CWPP), and mitigation projects in those plans, as funding allows.*	Wildfire
	ONG	*b. Encourage communities with completed plans to seek hazard mitigation grant funding through annual Wildfire Risk Reduction (WRR) Grants to address projects identified in their CWPP as appropriate.*	Wildfire
	ONG	*c. Work with identified communities/residents to provide technical assistance in plan development, and to focus local activities to address their wildfire risks/vulnerabilities (where local willingness exists to take on such tasks) to educate on and promote the fire-related elements of their CWPPs, Firewise concepts, "fire adapted community" standards, etc.*	Wildfire

Objective	Target Date	GOAL 2: Reduce Property Damage Objective / Implementation Action	Primary Hazards Addressed
2.4		Ensure building requirements are consistent with minimum National Flood Insurance Program (NFIP) standards.	
	2024	*a. Collaborate with stakeholders to develop a pathway to bring Michigan into full compliance where state and local floodplain regulations do not meet minimum NFIP requirements as listed in 44CFR60.3.*	Flooding
2.5		Implement agricultural and environmental assurance programs to reduce onsite environmental risks and to mitigate against potential runoff.	
	ONG	*a. Conduct 1500 risk assessments (annually) across various Michigan Department of Agriculture and Rural Development (MDARD) programs, including but not limited to the Bulk Storage Program and Michigan Agricultural Environmental Assurance Program.*	Hazardous Materials
2.6		Collaborate with the United States Army Corp. of Engineers (USACE) on a southeast Michigan Pluvial Flood Study, done in conjunction with the Great Lakes Water Authority (GLWA).	
	2027	*a. If approved, leverage a USACE study to be funded by the Water Resources Development Act to aid in identifying why current efforts to sufficiently mitigate pluvial flooding in southeast Michigan are not fully working and to evaluate alternatives to address the problem. The study could start in 2024 and is estimated to take up to three years to complete.*	Pluvial Flooding

GOAL 3: Collaborate With and Increase Stakeholder Knowledge

Objective	Target Date	GOAL 3: Collaborate With and Increase Stakeholder Knowledge Objective / Implementation Action	Primary Hazards Addressed
3.1		Collaborate with and increase the knowledge of emergency managers, urban/regional planning organizations, and other relevant stakeholders about hazard mitigation planning principles, projects, and opportunities.	
	ONG	*a. Provide training and guidance about hazard mitigation processes, plan review standards, and project ideas.*	All Hazards
	ONG	*b. Encourage land-management and development practices that help reduce long-term hazard risks and vulnerabilities, and the integration of local hazard mitigation plans with other local/regional planning processes and regulations.*	All Hazards
	ONG	*c. Educate and collaborate with state and federal legislators to advance mitigation related goals and objectives.*	All Hazards
3.2		Utilize a FEMA Integration Team (FIT) position to partner with MSP/EMHSD to increase the knowledge of emergency managers, urban/regional planners, and the general public in accordance with objective 3.1.	
	2024	*a. Upon anticipated hiring in 2024, assist the department with 3.1(a) and 3.1(b), as well as by conducting other related initiatives as jointly determined by FEMA and MSP/EMHSD management after successful onboarding.*	All Hazards
3.3		Promote community resilience by advancing mitigation education and resource partnerships.	
	ONG	*a. Support whole community outreach programs such as the Prepare Fair, hosting a minimum of three such public outreach programs each year.*	All Hazards
	ONG	*b. Hold or help to conduct a Great Lakes Homeland Security Training Conference each year, to include resiliency related content.*	All Hazards
	ONG	*c. Add 10 new private sector partners to the Public Private Sector Partnership (P3) program each year.*	All Hazards
	ONG	*d. Add 10 new private sector partners to the P3 program resource list each year.*	All Hazards

GOAL 4: Execute Mitigation Related Administrative Duties and FEMA Programs

Objective	Target Date	GOAL 4: Execute Mitigation Related Programs and Administrative Duties Objective / Implementation Action	Primary Hazards Addressed
4.1		Maintain and strengthen partnerships with state agencies and other stakeholders as appropriate as it relates to collaboration with the Michigan Hazard Mitigation Plan (MHMP).	
	ONG	*a. Coordinate with other state agencies involved in resiliency activities, especially as it relates to hazard assessment and mitigation related objectives/actions.*	All Hazards
	ONG	*b. Participate with standing collaborative groups, including but not limited to the Silver Jackets, Michigan Climate Coalition, and Michigan Emergency Management and Chemical Security Coordination meetings.*	All Hazards
	ONG	*c. Attend public Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) general meetings, as well as MCCERCC Mitigation Committee meetings, to the fullest extent possible.*	All Hazards
4.2		Continually revise and enhance the MHMP to ensure it remains current, effective, and in compliance with the federal Disaster Mitigation Act of 2000 and the Emergency Management Accreditation Program (EMAP).	
	ONG	*a. Integrate data and findings from interim Michigan Hazard Analysis (MHA) updates and newly approved local hazard mitigation plans, with change log usage to describe updated content.*	All Hazards
	ONG	*b. Conduct at least two "partial" updates to MHMP publications in between their five-year planning cycles (or more as necessary) as a result of changing risks or new regulations.*	All Hazards
4.3		Encourage participation in mitigation grant programs throughout the state.	
	ONG	*a. Expand the sharing of successful applications that result in mitigation grant funding by annually posting FEMA grant selections on the MSP/EMHSD website.*	All Hazards
	2024	*b. Create a Compendium of Project Summaries for successfully completed mitigation projects, as a standalone publication by Dec 2024.*	All Hazards
	ONG	*c. Present at a minimum of two conferences per year to Michigan associations and councils of governments as part of elected official related mitigation education.*	All Hazards
	ONG	*d. Conduct at least ten webinars per year targeting local emergency managers at the county, city, university, and tribal levels.*	All Hazards
	ONG	*e. Encourage local jurisdiction participation in FEMA Region 5 application development webinars before Building Resilient Infrastructure and Communities (BRIC) program application periods.*	All Hazards (Grant Eligible)
4.4		Strengthen local hazard mitigation planning throughout the state.	
	ONG	*a. Promote and support the development, update, and timely approval of local hazard mitigation plans (including specialized plans, hazard mitigation projects, and activities).*	All Hazards
	ONG	*b. Monitor and track local plans to identify hazards that are becoming more frequent, damaging, or otherwise important in order to inform state level planning.*	All Hazards
	2024	*c. Revise and promote MSP/EMHSD Publication 207 (Local Hazard Mitigation Planning Handbook) by the end of 2024.*	All Hazards
4.5		Participate in new FEMA grants, loan programs, and initiatives as introduced.	
	2024	*a. Assist in establishing, implementing, and then fine tuning a new revolving loan fund in the state via the Safeguarding Tomorrow Revolving Loan Fund (STRLF).*	All Hazards (Grant Eligible)
	2024	*b. Leverage Michigan's Community Disaster Resilience Zone (CDRZ) designations for successful mitigation projects in areas that have been targeted by the Climate and Economic Justice Screening Tool.*	All Hazards (Grant Eligible)

Objective	Target Date	GOAL 4: Execute Mitigation Related Programs and Administrative Duties Objective / Implementation Action	Primary Hazards Addressed
4.6		Work to establish a new, state-funded hazard mitigation grant program, administered by MSP/EMHSD.	
	ONG	*a. Maintain a relationship with the MSP legislative liaison to be kept apprised of introduced mitigation related state legislation or administrative rules.*	All Hazards
	ONG	*b. Promote an MSP/EMHSD administered state-level hazard mitigation funding program to become a legislative priority.*	All Hazards
	ONG	*c. If approved, use the grant program to fund projects prioritized by MSP/EMHSD that FEMA does not provide funding for, or are worthy projects otherwise struggling to meet local matching fund requirements.*	All Hazards

Action Plan Caveats

- The preceding Action Plan was finalized after consultation with MDHHS as it related to potential pandemic objectives, and with DTMB as it related to cyber hazards and cyber terrorism. Both of these hazards are highly technical in nature and fluid, based on sometimes daily changes for detected virus strains and cyberattack modalities and strategies. In the case of pandemics, MDHHS had just finalized a new pandemic plan near the time the 2024 MHMP was finishing its planning process. For cyber hazards, a new plan was in the final stages of development and was expected in the first half of 2024. It was determined that MDHHS and DTMB respectively concurred with the prioritized emphasis of these hazards as found in the MHMP and were best positioned to implement the programs related to these specific hazards. Discussions on public health emergencies and cyberattacks will continue to be part of the MSP/EMHSD Stakeholder Preparedness Review (SPR) and their status will be revisited after the 2024 MHMP has been published to determine if any additional measures should be specifically added to this plan.
- The MHMP considers all of the objectives in the Action Plan as important (see Section 3). As part of its official guidance, FEMA additionally requires that the plan further evaluate the objectives to prioritize some implementation actions over others. The MCCERCC HMC, State Hazard Mitigation Officer (SHMO), and State Planner therefore selected some objectives as being of "highest priority" (as opposed to standard priority) after holding a special meeting on the topic. Objectives that achieved a consensus were selected, with those that aligned with the prioritized hazards contained in Chapter 4 being an especially important factor. The following eight objectives/implementation actions were ultimately chosen as being of the highest priority: 1.1c, 1.2a, 1.3b, 1.4b, 2.1b, 2.4a, 2.6a, and 4.5a. In order to meet HHPD grant program eligibility, actions related to high hazard potential dams were also considered during this process.
- Funding for Action Plan related objectives, where program specific, are primarily noted in Appendix 10. As a short overall funding summary, MSP/EMHSD staff activities that are provided via FEMA programs and available to the state and local governments are also outlined in Chapter 5. In some cases, activities performed by other state departments may be accomplished by the State of Michigan budget and appropriations process.
- Details on how the Action Plan will be monitored in order to track progress is also included in Appendix 10, as is information related to closeout for Action Plan items from the 2019 MHMP.

APPENDICES

Appendix 1: Plan Development and Processes

This appendix provides a historical summation of the 2024 MHMP's creation, as well as information on stakeholder participation and an overview of the planning process.

Section 1: Plan Development and Coordination for the 2024 Plan

Plan development for the MHMP is a constant, iterative process that seeks to build and improve upon past editions of the MHMP and related publications. The previous content is compared to prior plan feedback, including from FEMA, as a starting basis for updating the publication. Preparation began shortly after approval of the 2019 plan, with preliminary discussions noting the following opportunities/challenges:

(1) FEMA's determination that the 2019 plan could benefit from reorganization and the use of less text.
(2) Anticipated changes to FEMA's guidelines/requirements, prior to the plan's next full revision.
(3) The upcoming 2020 decennial census necessitates the incorporation of new population figures.
(4) Climate change makes historical trends and information potentially less reliable.

A new planner was hired in March of 2020 and began onboarding with MSP/EMHSD as the state transitioned to a work from home environment due to COVID-19. Before being tasked with updating the MHMP, initial work focused on assisting the State Emergency Operations Center (SEOC) and its activation. Work on the MHMP was begun as the pandemic slowed and was conducted in a parallel fashion where possible. The communicable disease was a necessitated beginning focus, classified by MSP/EMHSD as a human-related hazard. Other human-related as well as technological hazards were analyzed during this time. Planning centered on known challenges and determination for how to best pivot to the analysis of natural hazards as required by FEMA for the 2024 MHMP.

A brief timeline of later MSP/EMHSD State Planner activities and select milestones is included, with a list of participants also provided. Timelines are listed primarily by starting date but may also include a string of subsequent similar activities where grouping by subject is additionally desired. An abbreviation for the State Planner (SP) is used only in the following timeline.

Select Activities and Milestones

2021

February 2021

- As required by EMAP, the SP was tasked with updating publications as they related to direct risks to Michigan's emergency management program.

March 2021:

- Consideration was given for pursuing either a standard or enhanced plan. Resource limitations led to choosing standard plan requirements. It was also decided to expand collaboration with the National Weather Service (NWS) and more fully partner with the Great Lakes Integrated Sciences and Assessments (GLISA) organization.
- The SP provided assistance to the revision of the MEMP, contributing where asked and also using the contact with state agencies to contribute to information gathering for the MHMP. The SP was part of seven MEMP related meetings held during March thru May.

April 2021:

- Active collaboration with the SP and GLISA begun, in part to get feedback on the 2019 MHMP, its hazard taxonomy, and its objectives. Similar meetings with the NWS took place during this time, sometimes jointly with GLISA. A total of at least eight formal meetings were held between April and November.

June 2021:

- The SP began preliminary work on those hazards where GLISA and the NWS were not serving as primary subject matter experts. Other potential partners began to be identified and collaborated with. As an example, alternate experts were sought in order to gain a better understanding of earthquakes, subsidence, and space weather as the year progressed.

July 2021

- The SP gave a presentation to the MCCERCC to discuss its interface with the MHMP and begin its collaboration process with the 2024 plan. Another meeting was also attended in August.
- The SP met with the SHMO on the progress of objectives in the 2019 plan, their continued relevance, and potential gaps/needs.

August 2021

- Building off of July, the SP held two separate meetings in conjunction with their supervisor related to the progress of plan objectives with specific stakeholders (GIS and Local Planning). A later meeting with the MCCERCC HMC Chairperson and SHMO was also held related to objective progress.

September 2021

- A prominent interim update to the MHMP was necessitated when EGLE applied to the HHPD Grant Program. The FEMA and EGLE determined eligible dam locations and continued meeting with stakeholders involved with a successful grant application (including the Four Lakes Task Force). The SP began to robustly coordinate for HHPD MHMP compliance, with the SP being part of three meetings and webinars related to the program during September and thru the end of the year.
- The SP began collaboration with MSP/EMHSD staff conducting the SPR process and, similar to their work with the MEMP, used meetings to help inform future MHMP efforts even as the 2019 plan was being referenced. Two meetings were attended from September and October.

November 2021

- The SP met with SHMO staff to discuss ways the MHMP could be made more concise while still remaining effective. The mitigation strategies section was targeted, as were other sections with historical information that could either be placed onto the internet with hyperlinks or otherwise archived in past editions of the plan.

December 2021

- The SP attended a SEMC meeting and discussed how the state agencies would begin to contribute to the revision of the MHMP in 2022, similar to how they had been working with MSP/EMHSD on the MEMP and SPR in 2021

2022

January 2022

- The SP attended a MCCERCC HMC meeting to informally contribute to discussions/reviews for project applications. The SP attended meetings with the MCCERCC, its HMC, or the HMC Chair at least nine other times over the course of the year. The SP initiated or presented at some of these meetings, primarily regarding the progress of objectives from the 2019 MHMP, the sharing of pertinent data, and discussions on which hazards and objectives should be highlighted in the 2024 MHMP.

February 2022

- Plan work related to state owned infrastructure, as well as general Critical Infrastructure and Key Resources (CIKR), was identified as needing a lengthy period of time to update for the new plan, primarily from stakeholders outside of MSP/EMHSD. From February through December, the SP met with relevant representatives of the DTMB, the Michigan Economic Development Corporation (MEDC), and the Cybersecurity and Infrastructure Security Agency (CISA), as well as MSP GIS and Intelligence Operations Division (IOD) staff. At least 17 meetings were held between February and December.
- Work continued on the plan to obtain HHPD compliance. The SP coordinated at least nine related meetings between February and May.
- The SP held seven individual meetings with the MSP/EMHSD District Coordinators regarding what they were seeing on the ground as it related to hazards and community considerations.
- The SP continued to attend state agency SEMC meetings, using the February 16 meeting to lay the groundwork for a later SEMC specific MHMP group meeting that same month. Additional SEMC group meeting were held in March and April. Individual agency meetings were also held throughout the year, with the SP coordinating at least an additional 40 meetings with state agencies, pseudo-governmental organizations, and related stakeholders through November.

March 2022

- Coordination began with the SP and a newly hired FEMA FIT member located in Michigan. Several meetings were held, primarily related to the position collecting input and seeking feedback as they travelled, met, and worked with stakeholders across the state. Other discussions centered on their involvement with whole community land use management education. In addition to two in March, additional meetings occurred in April, May, and July on various topics. This particular FIT member ultimately took a new position and their involvement with MHMP related planning ended.

April 2022

- New guidance was released by FEMA regarding additional requirements that would be needed for the 2024 MHMP. Follow-up meetings were held with FEMA to better understand the changes.

May 2022

- The SP conducted a meeting with GLISA to discuss the impact of the new standards on their contributions. In addition to the May meeting, the SP met with GLISA at least seven more times before the end of the year on a variety of MHMP related topics as they collaborated on plan revision along with the NWS.
- An emphasis was begun to seek tribal input from their emergency management programs or related positions, eventually leading to the involvement of MSP/EMHSD District Coordinators. The use of Threat and Hazard Identification and Risk Assessment (THIRA) related surveys being conducted by Tidal Basin was later discussed, with Tidal Basin adding tribal contacts to the survey. These efforts were conducted primarily over 5 meetings which stretched into June and July.
- Other synergies with SPR and THIRA processes continued to be explored, with the SP attending seven meetings between May and November.

July 2022

- A HHPD compliant version of the 2019 MHMP was placed onto the MSP/EMHSD website in July (FEMA granted its approval in an expedited manner after it had received a preliminary draft for review). Work then pivoted to making sure the 2024 MHMP would remain HHPD compliant, with the SP later coordinating two additional meetings before the end of the year.

August 2022

- The SP attended a public meeting of the full MCCERCC to provide a presentation on HHPD, as well as to take input or answer questions from the committee or general public.
- The SP met with the SHMO regarding the plan, including on the linkage of hazards to mitigation projects, the progress of goals and objectives, and their discussions with the Governor's office.
- The SP provided a PowerPoint presentation regarding the planning process and a status update on the direction the 2024 plan was heading.

September 2022

- The SP attended meetings being conducted by MSP/EMHSD staff related to updating local emergency operation plan requirements. Assistance was given related to hazard specific annexes, and to receive input from local emergency managers regarding hazards in their jurisdictions. The SP attended eight of these meetings between September and December.

October 2022

- The FEMA planning specialist who had been providing guidance to the SP took a different position within FEMA. The SP began working with the newly assigned staff that same month, particularly as it related to their work with other states, how other states were approaching the plan (especially as related to the NRI), and the hazards seen in nearby states.
- Previously begun work began to culminate regarding more MHMP materials being placed onto the internet, with select materials put on the MSP/EMHSD website. Several meetings were held in the later part of the year. A Michigan specific NRI webpage was put onto the internet in December.
- A MHMP specific feedback email was created, and later used in conjunction with a physical and digital flyer seeking MHMP related input. The flyer became an input mainstay throughout the rest of the planning process and widely distributed. In addition to being provided to the full MCCERCC at later public meetings, the flyer was given to the Michigan Emergency Management Association (MEMA) to be distributed to their members in November. The flyer was also highlighted during a presentation by the SP on a local emergency manager webinar in December. District Coordinators distributed the flyer at select regional meetings as appropriate, and the flyer was also shared with FEMA personnel who were in contact with local stakeholders within the state.

November 2022

- The SP attended additional climate meetings, including those dealing with specific populations and climate related migration. It was also decided that the State Climatologist would contribute a stand-alone appendix on Michigan climate change for the MHMP (in addition to the climate related content that was already being incorporated into specific hazard chapters).
- The SP spoke before a public meeting of the full MCCERCC to discuss the MHMP as well as to receive feedback/input from the committee or the general public.
- Michigan formally ended the need for MSP/EMHSD COVID-19 related situation reports. This provided more time for the SP and key state agencies to work on MHMP related activities.

December 2022

- It was decided that a 2023 kick-off meeting for MHMP work related specifically to state agencies would be instead held in December to take advantage of a regularly scheduled year end SEMC Meeting.
- The new FEMA staff that had begun providing guidance to the SP in October was reassigned. A new person was put into place, marking the third staff member used by FEMA during the 2024 MHMP planning cycle.

2023

The planning and revision process accelerated in 2023, with over 100 relevant meetings held during the year. The following timeline aggregates these activities on a quarterly basis, with some summations made to limit redundancy.

First Quarter (January – March)

- The SP met with the MCCERCC HMC on January 4 as part of discussions related to the project scoring matrix, FEMA guidance requirement S10, social vulnerability, and equity. Additional HMC meetings were held in February and March. The SP also attended a separate public meeting of the full MCCERCC to be available to answer questions and receive input from committee members or the general public.
- The SP met with the SHMO on further MHMP related discussions, including FEMA guidance requirement S10, objectives tracking, safe rooms, and scoping grants. Two meetings were held, as well as an additional meeting with the Local Planner.
- The MHA was refreshed with minor interim revisions, primarily to reflect the closure of a state nuclear power plant and to elaborate on the COVID-19 outbreak (which had become significantly less severe over time).
- Hazard and climate related meetings continued with GLISA, typically on a schedule of at least once per month. At least five specific meetings were held before the end of March with either GLISA or the NWS.
- Two meetings related to HHPD revisions took place with EGLE in January and February.
- Multiple meetings took place related to CIKR, including but not limited to state buildings, Community Development Block Grant (CDBG) requirements, mapping, broader workgroups, critical bridges, electric reliability, and the program's own operations. At least four meetings were held in January, four in February, and one in March.
- The SP held discussions on vulnerable communities and special populations twice in the quarter, including with EGLE on the use of environmental justice tools.
- Multiple meetings took place with GLISA, as well as NWS, with at least six meetings being held.
- The SP was on the agenda for the February 8 SEMC group meeting. In addition to this meeting, the SP held or attended a total of at least six additional meetings with external state agencies. Additional meetings took place with professors at Michigan State University outside of GLISA to further expand the pool of subject matter experts. Consultations also continued with USACE.

Second Quarter (April – June)

- A multitude of meetings continued, with at least 45 meetings conducted from April-June. The meetings were similar to those held in the first quarter, including with MSP/EMHSD stakeholders (e.g., SHMO, Local Planner) as well as state, federal, and non-profit partners. Work to ensure HHPD compliance also occurred.
- The SP continued discussions regarding the NRI as a tool for use in the MHMP. At least three consultations were conducted with FEMA to discuss perceived data challenges potentially prohibiting more robust usage. It was ultimately decided that data gaps prevented the NRI from full incorporation into the plan, especially as it related to drought and coastal flooding datasets.

Third Quarter (July – September)

- A multitude of meetings continued, with at least 41 similar meetings held from July-September. Additional meetings of note included the beginning of ongoing monthly sessions with the Division Commander of MSP/EMHSD for additional input and direction.
- A full draft of the revised MHA was substantially completed by the end of July so that its major findings could be presented to the full MCCERCC on August 7 in order to answer questions from committee members and the general public. An additional request for plan input or feedback as it related to plan objectives was also made. This was followed by an additional meeting with the MCCERCC HMC on August 17 to ensure the draft's full content included MCCERCC's input and adequately reflected new priorities since publication of the 2019 MHMP.
- Work on HHPD components was completed and compartmentalized for standalone review, where possible. A draft of this HHPD related content was sent to FEMA in September.

Fourth Quarter (October – December)

- A multitude of meetings continued, with at least 40 similar meetings held from October-December (most meetings involved internal coordination beginning in November as the planning process began to wind down). Additional meetings of note included three status/input meetings with the Division Commander of EMHSD.
- Additional survey work was completed with MSP/EMHSD District Coordinators, as well as SEMCs, specifically as related to risks beyond natural hazards. District Coordinators were also part of additional input sessions as related to border hazards and other specialized topics.
- The SP continued coordination with MDHHS and DTMB regarding their pandemic plans and cyber plans (respectively) as it related to highly ranked hazards.
- Touchpoints were held with the EMAP coordinator after new guidance was provided by the organization. The new guidance came late in the 2024 MHMP planning cycle but ultimately proved largely similar to prior requirements.
- Specific MCCERCC meetings include two in October with the HMC to present and finalize inputs leading to the fine tuning of hazard mitigation goals and objectives. Coordination with the MCCERCC Annual Plan was also conducted prior to the upcoming full MCCERCC meeting on November 6. The SP conducted a presentation on the completed draft objectives and their rationale at this full MCCERCC Meeting.
- The SP sent preliminary drafts of plan components to FEMA throughout the quarter, the last parts of which were sent in mid-December.

2024 (January – April)

The MHMP was substantially completed in January, receiving minor refinements based on preliminary FEMA feedback to EMHSD's initial full draft submission from December 2023. The SP also presented the MCCERCC HMC with the draft, during which time they also identified which Action Plan objectives were of the highest priority. This modified full draft was then scheduled by the HMC to be placed before the full MCCERCC Council.

- A full draft plan, as recommended by the MCCERCC HMC, was approved by the MCCERCC Council during their January 22 public meeting.
- After approval by the MCCERCC, the plan continued to receive minor adjustments as necessary based on final agency feedback and additional FEMA comments. Modified full draft plans were sent to FEMA to seek official APA status for the plan. The version of the plan that was ultimately granted APA status was sent to FEMA on February 15, with FEMA officially sending an APA letter to MSP/EMHSD on March 11.
- The plan was then placed into MSP command channels for processing in order to receive signatures from MSP leadership before being sent to the Governor for the same.
- Once all statements of promulgation were received, the 2024 MHMP was presented to FEMA, which granted final approval. The 2024 MHMP officially replaced the 2019 MHMP in April of 2024.

Section 2: Contributing Agencies and Organizations

The MHMP and its associated publications were revised as a result of a collaborative effort with a variety of stakeholders, both within and outside of the state's emergency management program.

The Michigan Citizen-Community Emergency Response Coordinating Council plays an important role in the MHMP revision process, including through their involvement during full committee meetings (open to the general public) and via additional members with subject matter expertise in hazard mitigation. Specific hazard mitigation meetings included those that were regularly scheduled or ad-hoc depending on need.

Primary contributors regarding natural hazards included the NWS, the Great Lakes Integrated Sciences and Assessments organization, and the affiliated resources of the National Oceanic and Atmospheric Administration (e.g., National Integrated Drought Information System, Marine Program, Coastal Program). Multiple individuals participated from these organizations, including select meteorologists possessing either broad hazardous weather experience or specific subject matter expertise on more narrow topics.

State agency SEMCs participated in either group agency meetings or were targeted for specific planning and exploration meetings, including for technological and human-related hazards. Several state agency representatives participated multiple times, in some cases with either they or their representatives being part of more than ten meetings from 2021-2023. A partial listing of participating Michigan agencies that have SEMCs is included below, omitting acronyms to aid in FEMA plan review clarity.

Bureau of Aging, Community Living, and Supports
Department of Agriculture and Rural Development
Bureau of Civil Rights
Department of Corrections
Department of Education
Department of Environment, Great Lakes, and Energy
Bureau of Fire Services
Department of Health and Human Services
Department of Labor and Economic Activity
Department of Licensing and Regulatory Affairs
Department of Military and Veteran Affairs
Michigan National Guard
Department of Natural Resources
Michigan Public Service Commission
Department of State
Department of Technology, Management, and Budget
Department of Transportation

In most cases, these agencies also provided multiple specialized staff that were not SEMCs when dealing with specific issues. These representatives were sometimes housed in separate offices underneath primary organizational umbrellas, including but not limited to the Dam Safety Program, Michigan Community Service Commission, State Historic Preservation Office, Bureau of Construction, and Michigan History Center. Official state participants also include the State Demographer and State Climatologist. State related organizations involved in public and private partnerships included the Michigan Economic Development Corporation and Michigan State Housing Development Authority.

State agencies also aided in ensuring relevant pseudo-governmental entities (such as port authorities), regulated entities (such as power utilities), and local governmental collaborations (such as Catalyst Communities) were consulted with or otherwise taken into consideration. Michigan 2-1-1 was further partnered with to understand the needs of the state's broader communities.

Primary federal partners, outside of FEMA, included the United States Army Corps of Engineers and the Cybersecurity and Infrastructure Security Agency. Other consulted federal agencies included, but were not limited to, the United States Coast Guard, the Federal Energy Regulatory Commission, and the National Counterterrorism Center. Multiple meetings with FEMA Region 5 planning personnel, FEMA expert positions (e.g., Mitigation, Tribal, Building Codes Coordinator), and relevant mapping staff also occurred.

Subject matter experts from universities and nonprofit organizations were involved where additional contributions were desirable or necessary. The State Planner also regularly attended Silver Jacket, Michigan Climate Coalition, Local Emergency Management Webinars, and Michigan Emergency Management and Chemical Security Coordination meetings, whose collaborations also resulted in contributions to the revision of the MHMP and related publications. Attendees included many previously mentioned state agencies and organizations but also saw representatives from other groups such as the Animal and Plant Health Inspection Service, the USGS, and relevant non-profit organizations. Additional meetings and webinars were attended on a less frequent basis as they related to specific hazards and topics.

Section 3: Update Process Overview and Methods

The MHMP has traditionally been revised and updated as part of two primary processes, one involving Hazard Identification and Risk Assessment (HIRA) and the other leading to a core hazard mitigation plan of goals and objectives.

Both processes are iterative and build off of past efforts, using the results of previous publications as a starting basis. For the HIRA, previously identified natural, technological, and human-related hazards are further analyzed to determine their ongoing relevance. The potential for new hazards relevant to emergency management is considered along with any necessary changes to the characterization of existing hazards.

Identified hazards are assessed for associated risk and vulnerabilities, including upon people, property, the environment, and the economy. Impacts and consequences upon other areas, including but not limited to the operations of MSP/EMHSD itself, are also assessed in order to fully comply with FEMA and EMAP requirements. Hazard review and revision are augmented by the further compilation of historical hazard incidents, analysis of additional source material, and the review/input of individual subject matter experts. Other duties of the State Planner as they relate to updating the MHMP include:

- Monitoring open-source media, FEMA Region 5 resources, emergency operation center activations, and the Michigan Critical Incident Management System.
- Collaborating with:
    - Stakeholders within MSP/EMHSD, including but not limited to the SHMO, Local Planner, and District Coordinators.
    - Stakeholders outside of MSP/EMHSD, including state agencies and other subject matter experts at the federal, nonprofit, and academic levels.
    - Members of MCCERCC, including those with hazard mitigation subject matter expertise.
- Incorporating official guidance from FEMA and other emergency management related organizations.
- Taking part in relevant hazard related webinars and other training opportunities.

The diversity of the hazards and their associated data sources preclude a totally standardized approach to their analysis. Identified hazards are placed into related groupings, and the analysis within each hazard chapter makes use of the best readily available information in an attempt to cover all required FEMA risk assessment standards and EMAP vulnerability/consequence analysis requirements.

Risk can be thought of in many different ways (see methodology, below), but is often viewed as the general likelihood, frequency, or probability of a hazard occurring. Profiling a hazard involves looking at this risk of occurrence for a jurisdiction (e.g., state, county) and also examining the historical severity/magnitude of hazard related events.

Vulnerability for a jurisdiction considers severity and outcomes so that the impacts of hazard occurrences, referred to by EMAP as consequences, can be analyzed. Some areas described as being at high risk for a certain hazard may in fact be less vulnerable than assumed because of the low severity and/or limited consequences of an event in the jurisdiction. As an example, winter storms in Michigan are historically frequent, but due to preparedness and mitigation, the state may not be as vulnerable to the outcomes (impacts) of winter storms as another state, such as Texas. Other scenarios exist where devastating impact/consequence outweigh a relatively low historical frequency of a hazard.

Based upon these principles, natural hazards have their frequencies and impacts assessed in terms of impacts such as property damage, deaths/injuries, and other factors. Where possible, NCEI data is used to determine hazard frequency. See the MHA for more information regarding the use of the NCEI database. Additional data and maps are included from a variety of sources that may aid in providing additional information.

Analysis for technological and human-related hazards can be more difficult to find desirable state or county level data for, particularly in a manner that allows for “apples to apples” comparisons. In these cases, analysis is made to the extent that hazard data, surveys, event history, and the opinions of subject matter experts allow.

Other important factors are taken into consideration, including, but not limited to, hazard modifiers such as climate change. The location of urban centers, population cohorts/equity, population change, and land development are also considered. United States federal census data is updated in conjunction with online tools (e.g., NRI, RAPT) that address indexes and ratings for social vulnerability and other factors. While the NRI is a relatively newer tool, and one that has known limitations, it incorporates some data that MSP/EMHSD has traditionally used in prior plans while also attempting to expand upon it. The state is working with FEMA to improve the NRI, and based on these preliminary discussions has a high level of confidence that FEMA’s collaboration can expand the tool in a manner where it can serve a more robust role in future mitigation plans.

Local mitigation plans are reviewed to determine if other factors or trends need to be considered that could substantively inform the larger state plan. Previously mentioned state agencies may also have plans that directly or indirectly mitigate risk or otherwise contribute to making the state more resilient. These plans may augment the MHMP, some of which are particularly relevant regarding certain human-related or technical hazards.

Mitigation goals established in the previous MHMP are examined to determine their ongoing relevance and potential need for change based upon these previously mentioned assessments. These goals are further broken down into prioritized objectives that are consistent with obtaining such goals and grouped together to the extent possible (some objectives overlap with more than one goal). Objectives related to hazards of prominent concern may be assigned to MSP/EMHSD activities or considered against the resilience activities taking place across the state by other agencies or stakeholders. As part of these considerations, some objectives will be removed, some changed, and others added as compared to the previous edition of the plan. See Chapter 7, Section 3, for additional information.

Methodology and the Use of "Risk", "Probabilities", and "Frequencies" in the MHMP

"Risk" is a commonly used term in hazard mitigation that can carry somewhat different meanings. FEMA's official guidance (FP 302-094-2, released April 19, 2022) for state mitigation policies defines it as: "for the purpose of hazard mitigation planning, [risk] is the potential for damage or loss created by the interaction of natural hazards with assets, such as buildings, infrastructure, or natural and cultural resources".

This potential (i.e., risk) for many hazards can be demonstrated by either their probability or anticipated frequency of future occurrence. FEMA's official guidance (specifically, element S4) allows for these terms to be used somewhat interchangeably. As has been the case in previous editions of this plan, and for the reasons described below, much of the summary data presented in Chapter 4, Section 1, represents historical averages and frequencies.

While the MHMP tends to use frequencies, it should be noted that probability and frequency are technically and mathematically different. A probability has a value between zero and one, but a frequency may more flexibly express an annual chance of occurrence for very common events that happen many times per year. For example, it is more informative to know that snowstorms occur an average of 360 times per year (a frequency) than to learn that snowstorms have a 100% chance of occurrence each year (a probability).

Probabilistic concepts can be misinterpreted. For example, a "base flood" has a 1% chance of occurrence per year—a probability that may be calculated by engineers using extensive data, field measurements, and potentially complex models. Over a 100-year period, however, the cumulative chance of a flood occurring within that area is not 100%, as many laypersons might believe, but only 63.4% (due to the mathematical rules that apply to a sequence of conditional 0.01 probabilities over the course of 100 years: $1 - 0.99^{100}$). Even a 1% annual chance for flooding amounts to a 26% chance of it happening over the course of a 30-year home mortgage. It is also possible for a 0.01 probability flood to occur many times within a 100-year time period, just as flipping a coin several times may result in it always landing on heads as a result of sheer chance.

Hazard risks described in terms of their past or expected frequency of occurrence are one of the clearest and most straightforward analyses of risk. Mathematically, the expected frequency of occurrence can be estimated through the calculation of a simple average, with the number of significant hazard events divided by the number of years within the available historical records. For example, 50 snowstorms over a 10-year period result in an annual expected frequency of 5 snowstorms per year. As a second example, if 10 tornadoes occur during a 50-year period, then the annual expected frequency of tornadoes is 0.2, or 1/5, which (taking the reciprocal) can be expressed as an average of about one event every five years, on average.

Limitations and Precautions

While historical frequencies can be a helpful tool, it should be noted that climate change has greatly challenged assumptions that past events are able to accurately predict future estimates. Theoretical approaches, advanced modeling, or other techniques may be used where feasible (see Appendix 3 as an example). Simple proxies are otherwise sometimes helpful, especially for highly infrequent events such as a mass casualty foreign terrorist attack. Examining such an attack that occurred in a similar state may help to inform the risk for Michigan. Even then, such infrequent events may see annual estimates round down to zero, especially over longer time horizons. Great caution should be used before declaring such risks as being truly nonexistent, however. In some cases, the lack of a recorded event may be due to nothing more than the time frame being studied, statistical randomness, or other factors.

Appendix 2: Population, Land Use, and Demographics

The DTMB's Bureau of Labor Market Information and Strategic Initiatives Demography Team provided base data for Sections 1 and 2, with MSP/EMHSD District Coordinator regions chosen for analysis. These eight regions provide complete, non-overlapping coverage for the entire State of Michigan.

Section 1: Projected Population Changes for Michigan, 2020-2050

When analyzing the regions, it is important to note that Region 2 has been split into distinct regions (2N and 2S), and that there is no Region 4. The aggregation of smaller geographic units (counties) into larger geographic regions for this analysis may also mask county variation within regions. A listing of the counties within each region is included at the end of this section.

Projected population totals for the regions were sourced from county-level analysis by the University of Michigan Research Seminar in Quantitative Economics, originally conducted for MDOT. Citations should be credited as follows: *MDOT-Statewide & Urban Travel Analysis Section and U-M Research Seminar in Quantitative Economics*. The regional totals below employ a 2020 baseline and projected population totals for each provided decade.

Decadal Population Totals and Projections

Region	2020	2030	2040	2050
Region 1	1,081,439	1,107,877	1,147,498	1,149,972
Region 2N	2,313,026	2,383,570	2,498,172	2,542,754
Region 2S	2,316,690	2,309,171	2,345,770	2,359,390
Region 3	1,100,888	1,073,080	1,069,178	1,049,023
Region 5	965,800	982,378	998,969	998,760
Region 6	1,539,878	1,628,023	1,667,078	1,668,374
Region 7	448,963	465,976	473,868	467,897
Region 8	300,954	293,102	291,105	285,196

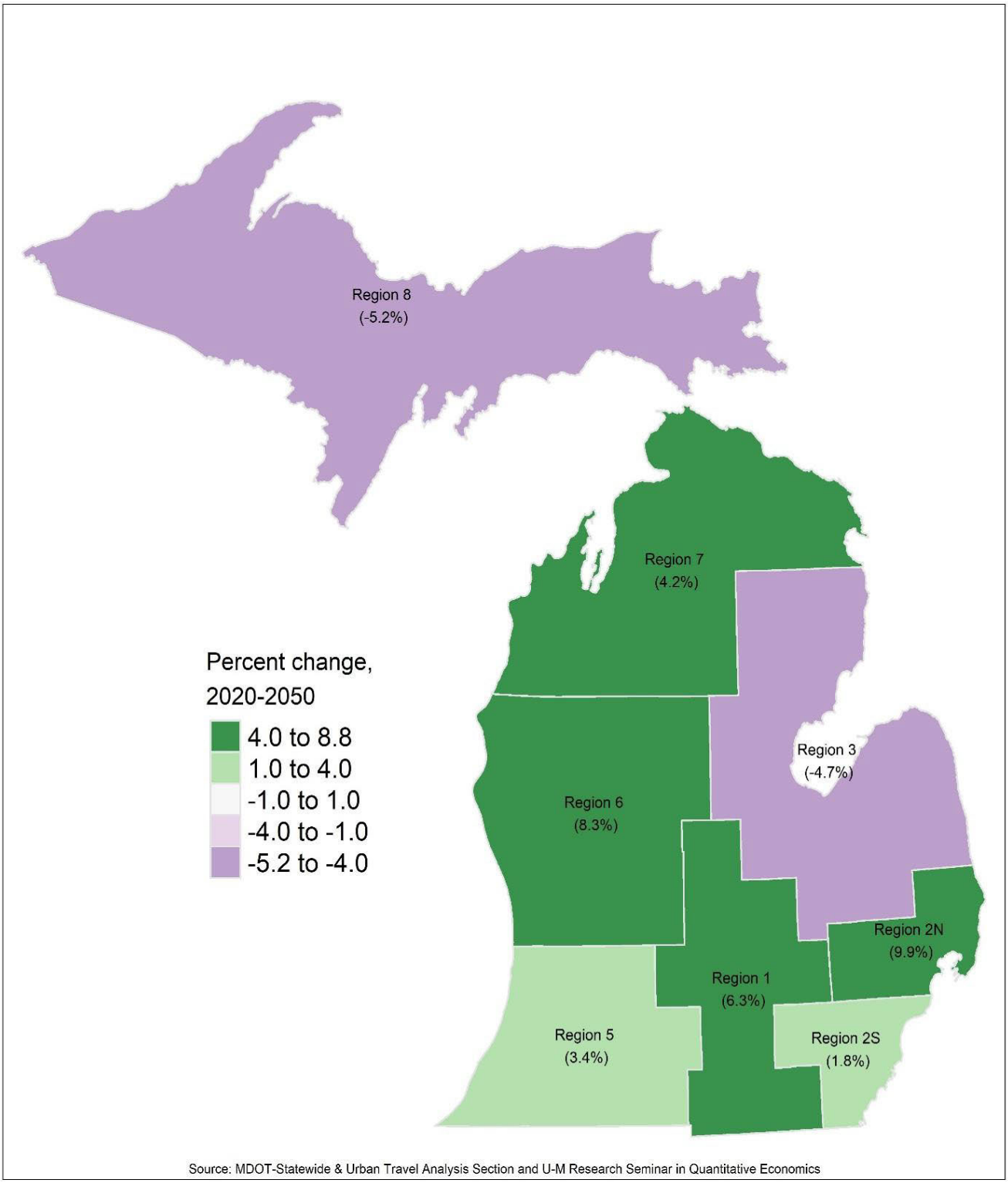
Numeric and percent changes in projected populations for corresponding decades are included below. The first three columns consist of the decadal population change from 2020 to 2030, 2030 to 2040, and 2040 to 2050. The fourth column consists of the population change over the entire 30-year period (2020 to 2050). Percent change is included in parentheses.

Projected Population Change (Numeric and Percent Change), 2020 to 2050

Region	Change 2020-2030	Change 2030-2040	Change 2040-2050	Change 2020-2050
Region 1	26,438 (2.4%)	39,621 (3.6%)	2,473 (0.2%)	68,533 (6.3%)
Region 2N	70,544 (3.0%)	114,602 (4.8%)	44,582 (1.8%)	229,728 (9.9%)
Region 2S	-7,519 (-0.3%)	36,599 (1.6%)	13,620 (0.6%)	42,700 (1.8%)
Region 3	-27,808 (-2.5%)	-3,902 (-0.4%)	-20,155 (-1.9%)	-51,865 (-4.7%)
Region 5	16,578 (1.7%)	16,590 (1.7%)	-208 (0.0%)	32,960 (3.4%)
Region 6	88,145 (5.7%)	39,055 (2.4%)	1,296 (0.1%)	128,496 (8.3%)
Region 7	17,013 (3.8%)	7,892 (1.7%)	-5,971 (-1.3%)	18,935 (4.2%)
Region 8	-7,852 (-2.6%)	-1,997 (-0.7%)	-5,910 (-2.0%)	-15,758 (-5.2%)

(source for both tables: *MDOT-Statewide & Urban Travel Analysis Section and U-M Research Seminar in Quantitative Economics)*

Projected Rates of Population Change in Michigan Regions, 2020-2050



Source: MDOT-Statewide & Urban Travel Analysis Section and U-M Research Seminar in Quantitative Economics

Notable data from Regional Population Analysis

- Regions 1, 2N, and 6, are the three regions that are projected to experience the highest rates of population growth from 2020 to 2050. These regions are generally in the southern half of Michigan's Lower Peninsula and include parts of Michigan's largest metropolitan areas. Each of these three regions is expected to experience a total population increase of 6% or more from 2020 to 2050, and growth is projected between each decade during this 30-year period.
- Regions 2S, 5, and 7 are projected to experience more varied trajectories of population change from 2020 to 2050. All three regions are projected to experience population growth by the end of the 30-year period. However, compared to the overall growth rate for Regions 1, 2N, and 6 from 2020 to 2050, Regions 2S, 5, and 7 are projected to have a lower overall growth rate from 2020 to 2050 (1.8%, 3.4%, and 4.2%, respectively). Moreover, all three regions have one decade in the 30-year period where they are projected to experience population decline.
- Regions 3 and 8 are projected to experience a population decline from 2020 to 2050. Region 3 is comprised of counties in the East Central Lower Peninsula, and Region 8 is comprised of all counties within the Upper Peninsula. In the 30-year period between 2020 and 2050, the total population is expected to decline by -4.7% in Region 3 and by -5.2% in Region 8. Both regions are projected to experience population decline between each decade from 2020 to 2050.

It is important to note that the regions' respective shares of Michigan's total population are not projected to shift to a significant degree between 2020 and 2050. The three regions with the highest projected growth (Regions 1, 2N and 6) together comprised approximately 49% of Michigan's total statewide population in 2020. This share is projected to increase to 51% by 2050. The combined shares of the remaining five regions are expected to decrease from 2020 to 2050. The share of Michigan's total population in the regions with more varied population trajectories (Regions 2S, 5, and 7) is projected to decrease from 37% in 2020 to 36% in 2050. The share of Michigan's total population in the regions projected to decline (Regions 3 and 8) is expected to decrease from 14% in 2020 to 13% in 2030.

Although the State of Michigan is projected to experience an overall population increase of approximately 450,000 persons from 2020 to 2050, this represents a relatively modest rate of population growth (4.5%) during this 30-year period.

County-Region Classification

Region	Counties
Region 1	Clinton, Eaton, Gratiot, Hillsdale, Ingham, Jackson, Lenawee, Livingston, Shiawassee
Region 2N	Macomb, Oakland, St. Clair
Region 2S	Monroe, Washtenaw, Wayne
Region 3	Alcona, Arenac, Bay, Genesee, Gladwin, Huron, Iosco, Lapeer, Midland, Ogemaw, Oscoda, Saginaw, Sanilac, Tuscola
Region 5	Allegan, Barry, Berrien, Branch, Calhoun, Cass, Kalamazoo, St. Joseph, Van Buren
Region 6	Clare, Ionia, Isabella, Kent, Lake, Mason, Mecosta, Montcalm, Muskegon, Newaygo, Oceana, Osceola, Ottawa
Region 7	Alpena, Antrim, Benzie, Charlevoix, Cheboygan, Crawford, Emmet, Grand Traverse, Kalkaska, Leelanau, Manistee, Missaukee, Montmorency, Otsego, Presque Isle, Roscommon, Wexford
Region 8	Alger, Baraga, Chippewa, Delta, Dickinson, Gogebic, Houghton, Iron, Keweenaw, Luce, Mackinac, Marquette, Menominee, Ontonagon, Schoolcraft

(source: https://www.michigan.gov/mdhhs/safety-injury-prev/publicsafety/ophp/contact)

Section 2: Land Use/Development in Michigan (2011 to 2019)

The same geographic regions employed in Section 1 are used in Section 2 in order to examine two different but interrelated measures of development: 1) change in population (2010 to 2020), and 2) change in land use (2011 to 2019). Slightly different timeframes were used based on the availability of data. The analysis first establishes a baseline level for regional development by examining regional population density in 2010 and the share of each region's total area treated as developed land in 2011. The analysis next examines each region's population change rate from 2010 to 2020 and each region's change in medium- and high-intensity development from 2011 to 2019.

Data Source and Methods

The population change analysis in each of the eight regions was measured using decennial Census data from 2010 and 2020. These data were sourced from the P.L. 94-171 Redistricting Data file.

The land use analysis in each region's baseline level of development (2011) and land use change (2011 to 2019) was measured using National Land Cover Database (NLCD) datasets. A full list of the eight major land use categories is available on the NLCD legend webpage. The eight major land use categories include water cover, barren land, forest, shrubland, herbaceous land, planted/cultivated land, wetlands, and developed land. Due to this analysis's emphasis on development, it focuses on the four sub-categories within NLCD's developed land category:

- Developed Open Space (Less than 20% impervious surface).
- Low Intensity Development (20-49% impervious surface).
- Medium Intensity Development (50-79% impervious surface).
- High Intensity Development (80-100% impervious surface).

Common Characteristics in the Four Developed Land Use Categories

Land Use Category	Classification Description
Developed Open Space	Mostly vegetative areas in the form of lawn grasses. Some constructed materials, but impervious surfaces account for less than 20% of total cover. These areas most commonly include large-lot single-family housing units, parks, golf courses, and vegetation planted in developed settings for recreation, erosion control, or aesthetic purposes.
Low Intensity Development	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 20% to 49% percent of total cover. These areas most commonly include single-family housing units.
Medium Intensity Development	Areas with a mixture of constructed materials and vegetation. Impervious surfaces account for 50% to 79% of the total cover. These areas most commonly include single-family housing units.
High Intensity Development	Highly developed areas where people reside or work in high numbers. Examples include apartment complexes, row houses, and commercial/industrial. Impervious surfaces account for 80% to 100% of the total cover.

(source: adapted from NLCD)

Results of the Development Analysis

The following two tables (labeled as A and B) highlight the results of this Section 2 analysis. Table A includes a baseline profile for each region. This profile includes the region's population density in 2010. The baseline profile in Table B also includes the proportion of each region's total land area that was developed in 2011, as well as the shares of developed land in each of the four developed land use categories (i.e., the respective share of developed land that is developed open space, low-intensity development, medium-intensity development, and high-intensity development).

Table B examines changes in population from 2010 to 2020 and changes in developed land use from 2011 to 2019. In terms of land use change, this analysis focuses on change in the medium-intensity and high-intensity developed land categories. To facilitate comparisons between the eight regions in each development measure, the regions are ranked from top to bottom within each column. The region's corresponding ranking is included in parentheses within that same column. For example, in the first column of Table A, each region is ranked by population density in terms of the most densely populated region (Region 2S, ranked first) to the least densely populated region (Region 8, ranked eighth).

Table A. Baseline Population Density (2010) and Developed Land Use (2011)

	Population Density, 2010 (people per square mile)	Total Area* that is Developed (2011)	Share of Developed Area that is Open Space (2011)	Share of Developed Area that is Low-Intensity, Developed (2011)	Share of Developed Area that is Medium-Intensity, Developed (2011)	Share of Developed Area that is High-Intensity, Developed (2011)
Region 1	193 (3rd)	12.9% (3rd)	45.1% (3rd)	35.9% (3rd)	13.8% (4th)	5.2% (4th)
Region 2N	1,042 (2nd)	40.5% (1st)	30.8% (7th)	31.2% (5th)	27.2% (2nd)	10.8% (2nd)
Region 2S	1,228 (1st)	39.9% (2nd)	23.9% (8th)	27.8% (7th)	33.2% (1st)	15.1% (1st)
Region 3	127 (6th)	10.7% (6th)	43.0% (5th)	38.4% (1st)	13.6% (5th, tie)	5.0% (5th)
Region 5	173 (5th)	12.8% (4th)	44.2% (4th)	37.6% (2nd)	13.6% (5th, tie)	4.7% (6th)
Region 6	179 (4th)	12.4% (5th)	42.8% (6th)	34.8% (4th)	16.2% (3rd)	6.2% (3rd)
Region 7	47 (7th)	7.5% (7th)	56.4% (2nd)	30.8% (6th)	10.1% (7th)	2.7% (7th)
Region 8	18 (8th)	4.0% (8th)	66.2% (1st)	23.5% (8th)	7.9% (8th)	2.5% (8th)

*The total developed area column is further broken down by development type in the remaining columns.

Summary of Baseline Population Density (2010) and Developed Land Use (2011)

Region 2N and Region 2S encompass most of metropolitan Detroit and the Ann Arbor metropolitan area. Together these regions form the two most densely populated regions in Michigan. Both regions entered this analysis with the largest shares of total land area that was developed in 2011. Both regions also had the highest concentration of medium-intensity development (single-family housing units) and high-density development (apartment complexes, row houses, and commercial-industrial land) in 2011.

Region 6 encompasses the Grand Rapids area and was the fourth most densely populated region in Michigan in 2010. Region 6 ranked fifth in terms of total developed land area and third in medium- and high-intensity development. Compared to other regions, Grand Rapids ranked low in terms of developed open space and moderately in terms of low-intensity development (mixture of constructed materials and vegetation and single-family housing units).

Region 1 encompasses the Lansing metro area and Region 5 encompasses the southwestern part of the Lower Peninsula. These two regions were the third and fifth most densely populated Michigan regions (respectively) in 2010. In terms of total land area that was developed in 2011, Region 1 ranked third and Region 5 ranked fourth. They also ranked similarly to one another in terms of the shares of their total developed land in the open space, low-intensity development, and medium-intensity development categories. The Lansing area ranked higher in terms of it high-intensity development compared to Region 5, which ranked sixth in high-intensity development among the eight Michigan regions.

Region 3 encompasses the northeastern part of the Lower Peninsula, Region 7 encompasses the Grand Traverse area, and Region 8 provides coverage of the Upper Peninsula. These three regions were the least densely populated regions in 2010 and also ranked the lowest in terms of their total developed land area in 2011. The Grand Traverse area and the Upper Peninsula ranked second and first, respectively in terms of the share of developed land that is developed open space (large-lot single-family housing units, parks, golf courses, and aesthetic vegetation). The Grand Traverse area and the Upper Peninsula had low rankings in terms of low-intensity development. In contrast to Region 7 and Region 8, the Northeastern Lower Peninsula (Region 3) ranked first in low-intensity development but fifth in its share of developed land that is developed open space. This suggests that developed land in Region 3 is concentrated in areas with a mixture of constructed materials and vegetation and single-family housing units. The Northeastern Lower Peninsula, Grand Traverse area, and the Upper Peninsula have low rankings in the medium- and high-intensity development categories. These low rankings reinforce that these three regions are sparsely populated and the least developed Michigan regions in terms of medium- and high-intensity land use.

Population and Land Use/Development Change in Regions

Table B displays how population and land use have changed in the regions over time. The first column displays the rate of population change from 2010 to 2020. Each of the eight region's corresponding ranking by population change rate is included in parentheses within that same column. The two columns to the right display the regions' change in the medium-intensity and high-intensity development relative to their total area in square meters. Each region's corresponding rank within each land use category is also displayed in parentheses.

Table B. Population and Land Use Change in MSP/EMHSD Regions

	Population Change, 2010-2020	Medium-Intensity Development, 2011-2019	High-Intensity Development, 2011-2019
Region 1	1.6% (5th)	18.5% (5th)	6.7% (4th, tie)
Region 2N	5.0% (2nd)	46.5% % (1st)	22.6% (1st)
Region 2S	0.1% (6th)	39.1% (2nd)	19.0% (2nd)
Region 3	-3.8% (8th)	14.8% (6th)	4.9% (6th)
Region 5	1.8% (4th)	20.9% (3rd)	6.7% (4th, tie)
Region 6	6.2% (1st)	19.7% (4th)	7.3% (3rd)
Region 7	2.2% (3rd)	9.2% (7th)	2.2% (7th)
Region 8	-3.1% (7th)	2.7% (8th)	0.9% (8th)

Region 2N (Macomb, Oakland, and St. Clair counties), Region 6 (Grand Rapids area), and Region 7 (Grand Traverse area) had the highest rates of population growth from 2010 to 2020 (5.0%, 6.2%, and 2.2%, respectively). Population growth was more modest in Regions 1, 2S, and 5 whose growth rates ranged from 0.1 percent (Region 2S) to 1.8% (Region 5). Region 3 and Region 8 experienced population decrease from 2010 to 2020. These regions encompass the northeastern part of the Lower Peninsula and the entire Upper Peninsula and experienced a population decrease of 3.8% and 3.1%, respectively.

Summary of Population and Land Use Change by Measure of Development

Medium-Intensity Development

- According to the NLCD detailed classification, the medium-intensity development category commonly includes single-family housing units and other areas where 50% to 79% of the total land cover is concrete/impervious surfaces.
- Region 2N and Region 2S encompass most of the metropolitan Detroit region and experienced the largest increases in medium-intensity development (46.5% and 39.1%, respectively). Regions 1, 3, 5, and 6 experienced relatively smaller increases in medium-intensity development (14.8%, 20.9%, 19.7%, and 18.5%, respectively). Region 7 and Region 8 encompass Grand Traverse Bay and the Upper Peninsula and experienced the smallest increases in medium-intensity development (9.2% and 2.7%, respectively).

High-Intensity Development

- High-intensity development represents areas where people reside or work in high numbers. All eight regions experienced an increase in high-intensity development from 2011 to 2019, suggesting an increase in apartment complexes, row houses, commercial-industrial areas, and other areas with some of the highest amounts of impervious surfaces. The regions which encompass most of the Detroit's metropolitan area, Regions 2N and 2S, experienced the greatest increase in high-intensity development (22.6% and 19.0%, respectively). Region 1, Region 5, and Region 6 experienced comparatively smaller increases (7.3%, 6.7%, and 6.7%, respectively). The Grand Traverse area (Region 7) and the Upper Peninsula (Region 8), also experienced increases in high-intensity development but had the smallest rate of increase relative to the six other regions.

Summary of Population and Land Use Trends by Region

Region 2N (Macomb, Oakland, and St. Clair Counties)

- Started at baseline as the second most densely populated region in 2010, with a high rate of population growth between 2010 and 2020.
- Started as the second highest ranked region in medium- and high-intensity development in 2011 and experienced the largest percent increase in medium- and high-intensity development between 2011 and 2019, ranking first in both categories.

Region 2S (Wayne, Washtenaw, and Monroe Counties)

- Most densely populated region in 2010 and low rate of population growth from 2010 to 2020.
- Ranked first in medium- and high-intensity developed areas in 2011 and a large percent increase in medium- and high-intensity development categories from 2011 to 2019, ranking second in both categories.

Region 6 (Grand Rapids area)

- Ranked fourth for the most densely populated region in 2010 and ranked first for the highest rate of population growth from 2010 to 2020.
- Ranked third in both medium- and high-intensity developed areas in 2011 and experienced a moderate increase in medium- and high-intensity development from 2011 to 2019.

Region 7 (Grand Traverse area).

- Sparsely populated in 2010 and experienced moderate population growth from 2010 to 2020.
- Started baseline with low ranking in medium- and high-intensity developed areas, with consistently low rates of medium- and high-intensity development from 2011 to 2019.

Region 1 and Region 5 (Lansing metro and Southwestern parts of the Lower Peninsula)

- Started with moderate to lower population density in 2010, with moderate rates of population growth from 2010 to 2020.
- Lansing metro ranked fourth in medium- and high-intensity developed land use in 2011, and the Southwestern part of the Lower Peninsula ranked fifth in medium-intensity developed land use in 2011 and sixth in high-intensity developed land use in 2011. Both regions experienced moderate changes in medium-density and high-density development from 2011 to 2019.

Region 3 (Northeastern part of the Lower Peninsula) and Region 8 (Upper Peninsula)

- Started as sparsely populated regions in 2010 and experienced a population decrease from 2010 to 2020.
- Started with low baseline levels of medium- and high-intensity development in 2011 and experienced low rates of medium- and high-intensity development from 2011 to 2019.

Section 3: Development Implications for Michigan Hazards

Analysis for the influence of land development on hazard impacts is included in the hazard summary table of Chapter 4, with hazards assigned interaction ratings of positive (+), neutral (=), or negative (-). The rationale for these ratings is based primarily on the effects of increased development and trends upon a hazard's ability to cause damage to property (e.g., buildings, infrastructure) or injure people. The specific rationale for rankings includes:

1. Lightning can occur at somewhat random locations across the state (as driven by thunderstorm patterns). The more developed land exists in these areas the greater the chance a strike will cause damage or injury (although larger/taller buildings may have lightning protection systems). Where development removes large amounts of trees the risk of wildfires caused by lighting should be lessened (see wildfires). Given competing factors the net effects have been estimated as closer to neutral.
2. Hail is also a weather hazard that outside of being driven by thunderstorm patterns can occur at somewhat random locations. For this reason, it is slightly more likely to cause damage to the extent that more land areas see development. Rating: +.
3. Tornadoes and high wind property damage have a strong correlation with increased areas of developed land. Tornadoes are also common in areas of the state seeing growth and development. Rating: +.
4. Snow, freezing rain, and sleet share some commonalities with the assessment of hail. Lake effect snow is more common on the west side of the state, an area that is seeing growing development. Because freezing rain tends to occur when temperatures are at or near the freezing mark, the heavily populated southern Lower Peninsula is at an increased risk of ice storms. Rating: +.
5. Extreme cold may cause damage to water mains and pipes. However, Michigan has also been considered a cold weather state for some time, and the nature of built infrastructure tends to reflect this (e.g., insulation, pipe depth). The net effects have been estimated as neutral.
6. Flooding assessment for development varies somewhat depending on the type of flooding. Pluvial flooding can occur in rural areas, but its greatest impacts in Michigan are upon more urban areas. Even as some affected cities may see declines in population, most infrastructure and their impervious surfaces remain (and with lower tax bases, may be harder to maintain). Although new construction in previously undeveloped areas may use mitigation methods to decrease pluvial flooding, the net effect of more development means additional runoff will occur. Rating: +.
7. Great Lakes shoreline hazards, considered here primarily as related to flooding and erosion, would tend to increase as more development takes place along Michigan shores. Rating: +.
8. Dam and levees are themselves characterized as, and may be a consequence of, development. Although an increased use of structural flood protection measures may be necessary to prevent floods in some areas, their existence creates a potential new risk for flash flooding if they are overtopped or otherwise fail. The net effects of new land development on existing dams can be highly variable, but risks would be expected to increase to the extent new development increases the amount of impounded water dams are holding back. Rating: +.

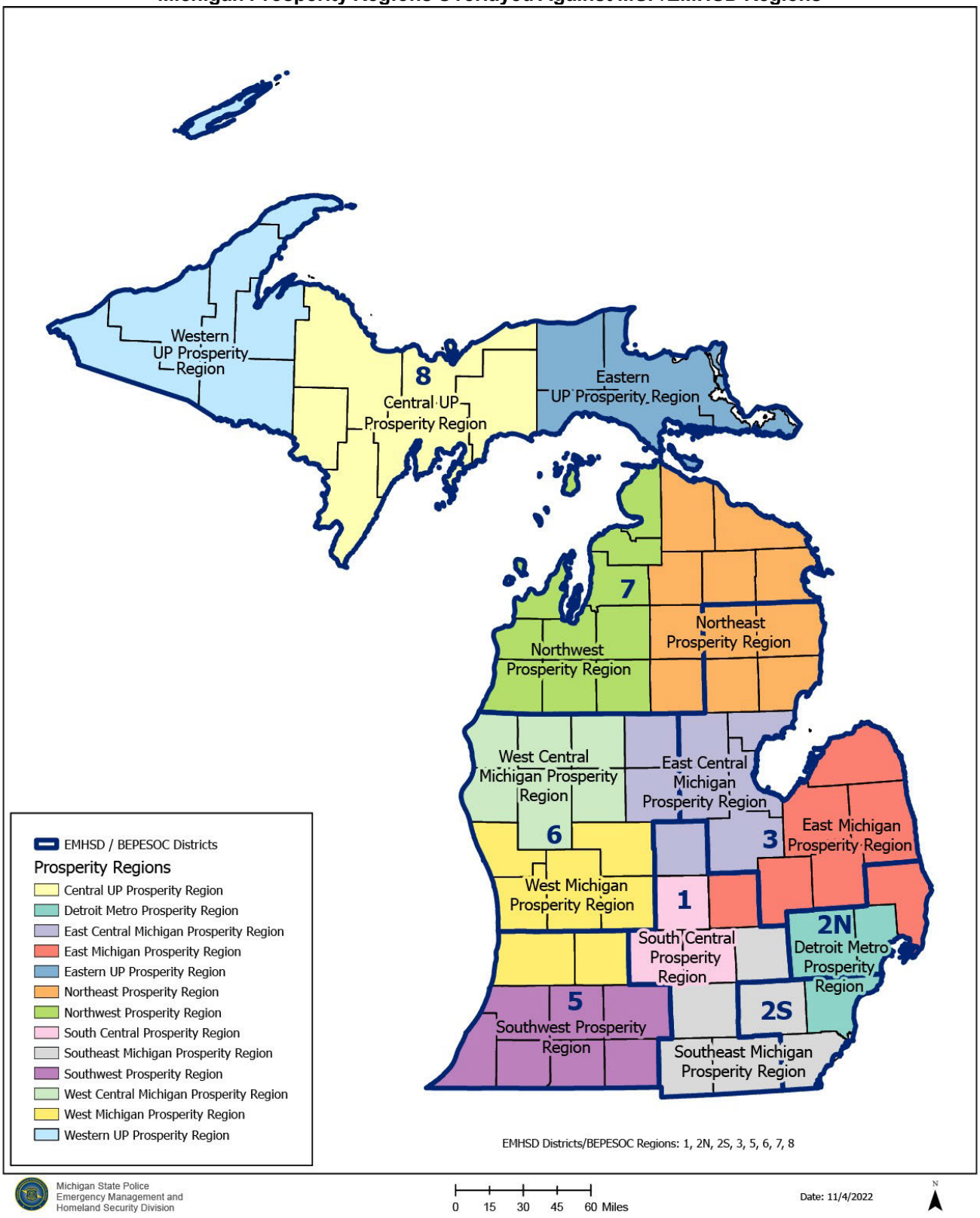
9. Extreme heat tends to be retained by concrete, roads, and dark roof surfaces. In general, more development increases the effects of extreme heat. This can be due to the impacts of heat on infrastructure (e.g., road buckling), and people. Although some populations may be moving to areas where urban heat island effects are lessened (e.g., suburbs), extreme heat overall tends to be exacerbated by development. Rating: +.
10. Drought may be exacerbated by increased development to the extent that it means a higher population and increased demand for water. However, water needs may simply be shifted, and impacts depend on the placement of aquifers and water sources. Assessment of the state as a whole for this relationship is difficult and treated as neutral.
11. Wildfire risk tends to be lower for areas where trees are removed in exceptionally large lots for development, as fuel sources are decreased. However, some less intense development simply means more people moving into wooded areas. Wildfire rates may slightly increase, but detection and response times tend to increase as well. Overall, more structures placed into fire prone areas leads to more property damage. Rating: +.
12. Invasive species have unclear interactions with development due to widely different variables among species and their acceptable habitats. To the extent species can't live in urban areas, development may slow their movement to an area. Many species are highly adaptable however and are sometimes spread by traveling vehicles which may increase due to development. Overall climate trends are probably more of a primary factor, and the net assessment for land development is neutral.
13. Earthquakes and subsidence can damage property (e.g., buildings, pipelines), and all other things being equal would indicate a positive relationship with increased development. Major impacts for earthquakes in Michigan are minor, however, and new development into areas where subsidence is more of a concern does not appear to be significantly taking place. High rise structures in Michigan are not common outside of some urban areas. For Michigan, a net assessment for these hazards is considered neutral.
14. Meteorites and other impacting celestial objects would hit within Michigan in highly random locations. Although the risks are slight within the timeframe of this plan, there is an association between the increase in built structures and developed land for this hazard. Rating: +.
15. Space weather typically has direct impacts on certain types of equipment and vehicles as opposed to structures. However, electrical infrastructure and pipelines can be affected, and to the extent development increases this infrastructure more problems may occur. While some areas of the state are more prone to these effects than others, many impacts may affect wide areas of the state. The overall rating is neutral.

Technological and human-related hazards are affected in a nuanced manner by development. Effects may be highly specific to areas and the nature of the development (e.g., high intensity, low intensity). Denser urban areas may be at higher risk for terrorist attacks or civil disobedience, but some development trends in Michigan see more people leaving these areas in some parts of the state. Increased or even shifted demand for heating and cooling may lead to more energy failures or shortages depending on specific grids. For other hazards, having populations more spread out can be beneficial. This may be the case for certain public health emergencies (e.g., pandemics) or nuclear attack. Cyberattacks is an example of a hazard that likely has little correlation to development, especially on a statewide level and as more internet services are provided by satellites.

Section 4: Prosperity Region Demographics and Social Vulnerability

The DTMB maintains an extensive website providing detailed information for Michigan residents broken down into ten Prosperity Regions. These regions differ from the eight MSP/EMHSD regions used in Sections 1 and 2.

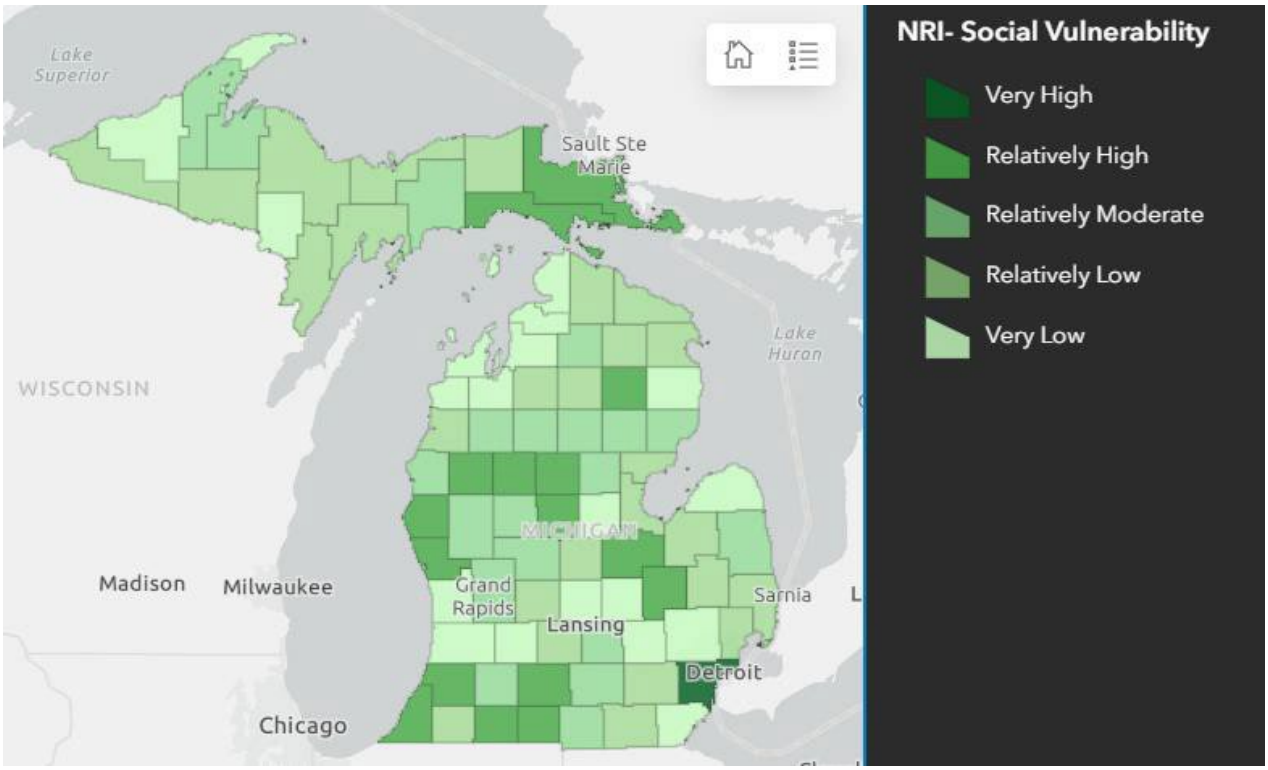
Michigan Prosperity Regions Overlayed Against MSP/EMHSD Regions



Detailed 2022 Annual Planning Information and Workforce Analysis Reports are available for all ten Prosperity Regions, generally provided in two areas for analysis: (1) Workforce Analysis, and (2) Planning Information. Planning Information reports provide population information broken down by age, sex, race/ethnicity, education, and workforce (by industry).

Population figures and demographics are also provided for those living below the poverty line. The MHMP uses combined related indicators, such as Social Vulnerability (part of NRI data), in order to identify socially vulnerable geographic areas based on demographics (also available at the census tract level, not shown).

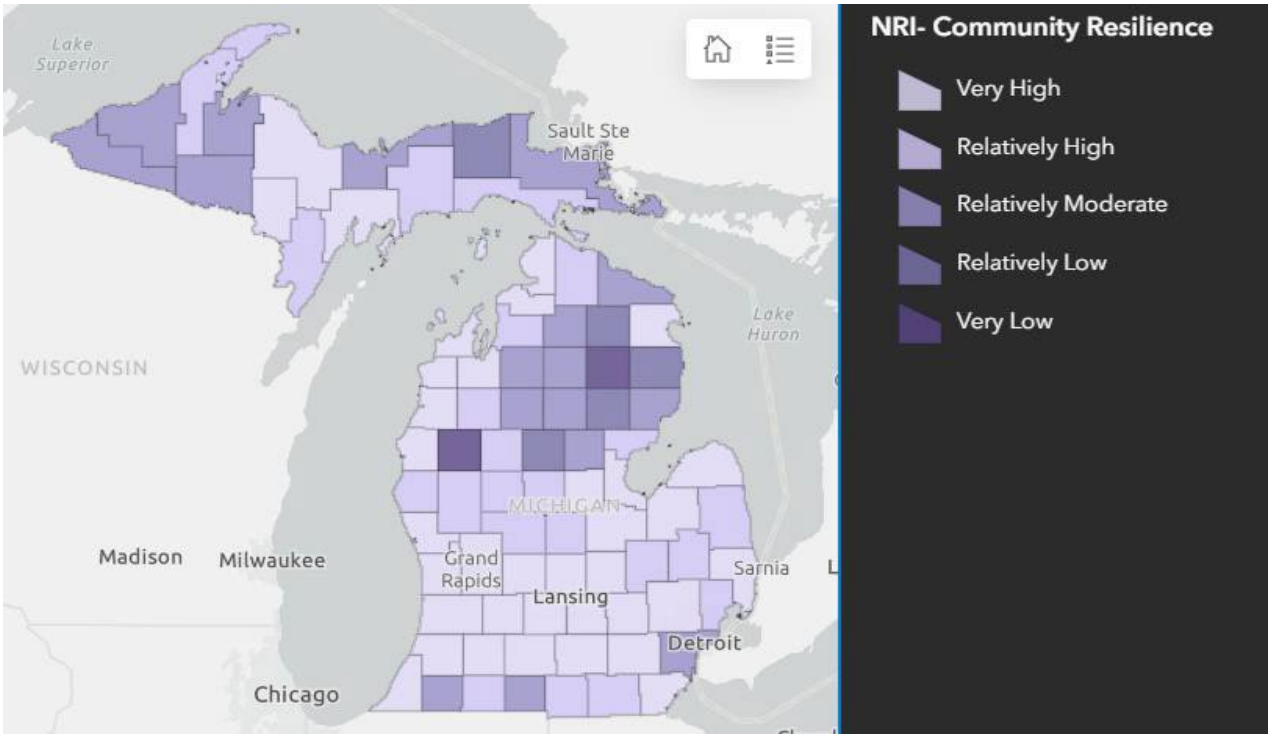
Social Vulnerability by County (Michigan)



(source: NRI, data as of November 2022)

The same NRI webtool can be used to determine Community Resilience, which represents the ability of a community to prepare for anticipated natural hazards and how quickly they may be able to recover from them.

Community Resilience by County (Michigan)



(source: NRI, data as of November 2022)

Section 5: Overall Population, Land Use, and Demographic Considerations

Information taken from the previous sections demonstrates that Michigan, while growing, is only expected to see moderate increases in population (4.5%) for the period of 2020 to 2050. Using MSP/EMHSD regions as a basis for analysis, Region 8 (Upper Peninsula) is however expected to lose population. Region 3 is expected to show a similar decline, representing areas such as the Thumb, the Metro Flint area, and some areas along Lake Huron. Region 2N will grow the most, while Wayne County (part of Region 2S) is anticipated to see only slightly positive, near flat growth. Region 6, in general, typified by the Grand Rapids area, will see robust growth, as will many western communities along the shores of Lake Michigan. While this anticipates some small shifts in population growth towards the middle and western parts of the Lower Peninsula, it is not characterized as dramatic. It should also be noted that different counties will deviate from their regional trends, sometimes significantly. How the general population reacts to rising temperatures, both in and out of state, is currently difficult to study but may see people moving to more northern locales near fresh water. See Appendix 3 for additional information.

A land use analysis for 2011-2019 (Section 2) shows all eight regions experienced an increase in high-intensity development, suggesting an increase in apartment complexes, commercial-industrial sites, and other areas where concrete/impervious surfaces are generally high. Some southeast portions of the state (i.e., Regions 2N and 2S) experienced the greatest increase in high-intensity development (22.6% and 19.0%, respectively) and contain a high level of impervious surfaces. For Region 2N and to a lesser extent the Grand Rapids area, their projected population increases (Section 1) indicate an expectation for further high-intensity development.

While Wayne County is anticipated to have a lower level of population growth compared to most of the west side of the state, its SVI ranking (Section 4) also shows that a greater proportion of residents in the area are part of social groups that may be disproportionally affected by natural hazards. Other parts of the state have similar but slightly less pronounced vulnerable counties, including Genesee and Saginaw Counties, several counties in the southwest portion of the Lower Peninsula, and the Muskegon area. Some rural counties, including in the Upper Peninsula, also score relatively poorly. A census tract level analysis, beyond the scope of this publication, shows high variability within most counties that contain a more urbanized core. Rural poverty can also be significant in some areas.

Looking at Community Resilience (Section 4), similar patterns emerge. However, the Upper Peninsula shows more of a mixed picture, likely due to lower governmental resources that demonstrate factors beyond only social vulnerability need to be considered. Some other rural counties in the Lower Peninsula, notably Lake County and Oscoda County, score the most poorly based on this factor. This would be expected to be exacerbated to the extent that many of the counties in the Upper Peninsula and northern Lower Peninsula are expected to see decreases in population.

Several hazards, and their impacts, can be linked to increased damages based on higher populations or intensely developed land. Notable hazards in these cases include pluvial flooding, frequently made more prevalent by a greater amount of impervious surfaces and more damaging due to a population's associated buildings/infrastructure. Extreme heat is also a concern in high population/high development areas, as building materials often create features that both attract and retain heat (e.g., concrete, rooftops, roads). These hazards are expected to become worse, due in part to climate change, with an increase in thunderstorms bringing more rain to the area. This holds true for the Metro Detroit area, which is already experiencing problems due to pluvial flooding. A general and modest shift in population growth from the east of the state towards the west also indicates that these growing areas will need to anticipate development and plan to minimize problems associated with pluvial flooding and urban heat island effects. These areas however may also have fewer socially vulnerable communities and a greater degree of community resiliency.

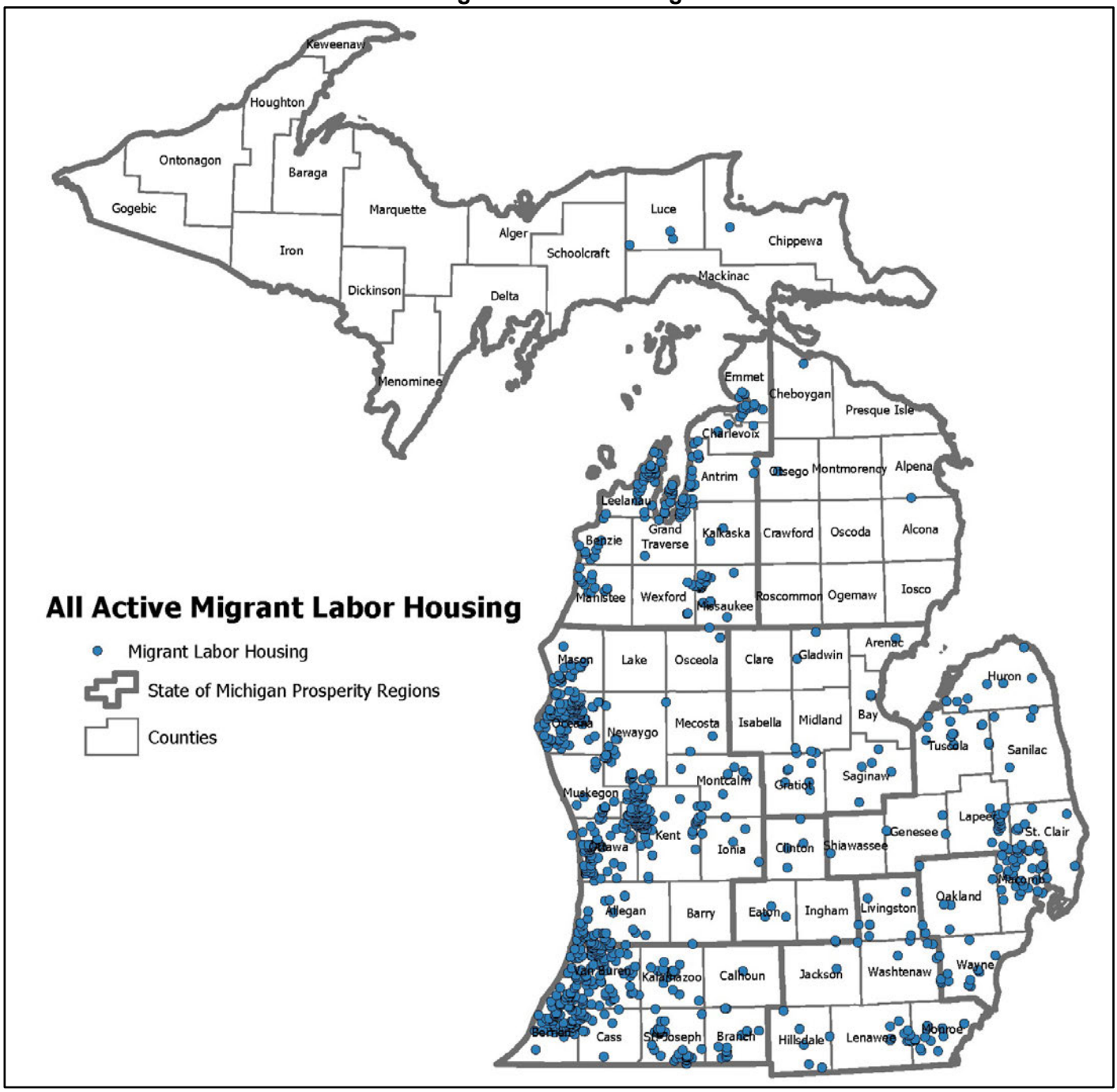
Most considerations to a hazard analysis based on population factors is modest in the MHMP due to the relatively small amount of change anticipated across the state. To the extent that the population in the Upper Peninsula shrinks, there would, all other things being equal, exist less of a relative wildfire risk (to people and buildings). To the extent relatively more people will live closer to the Lake Michigan lakeshore, they will be exposed to "lake effect" snow and similar meteorological phenomena associated with the impacts of the Great Lakes upon weather (some of which may also be beneficial). Portions of these areas may see marginally increased frequencies of damaging high wind related events.

Takeaways gleaned from Sections 1-4 relate to continued concern for pluvial flooding in Regions 2S, and its increased future potential in Regions 2N and 6 (along with some other areas of the state). Extreme heat concerns may also increase in some of these same areas, although they can be somewhat mitigated for localities that are in closer proximity to the Great Lakes (especially for rural communities receiving westerly winds across Lake Michigan). Region 1, which includes the State Capitol in Lansing and several prisons in Jackson, is expected to in general see above average population growth. While hypothetically putting the area at a relatively higher risk for civil disturbances and other human-related hazards, the region's natural hazard profile and social vulnerability does not generally present as many challenges as other areas of the state containing a high level of state assets (such as Wayne County).

Section 6: Additional Population Maps

Emergency management benefits from a greater understanding of temporary communities (migrant farming) or those that largely eschew technology (such as mechanized transportation and cell phones for certain Amish communities).

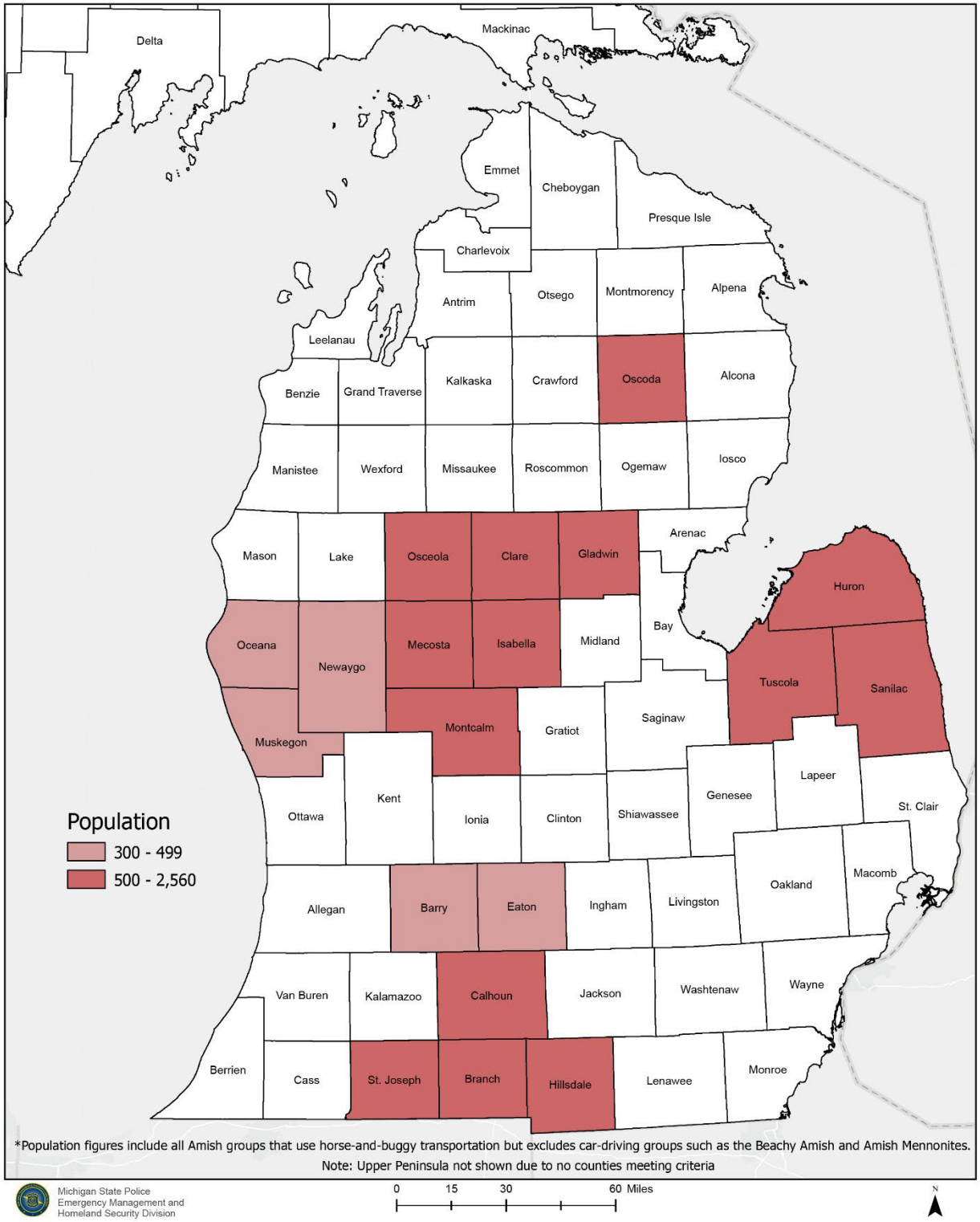
Migrant Labor Housing



(source: MDARD Migrant Labor Housing Program, Fiscal Year 2023)

Seasonal agricultural needs have led to migrant workers playing an important role in the planting, cultivating, and harvesting of a variety of crops. The Migrant Labor Housing program oversees licensed housing within the agricultural industry. Migrant housing is located at nearly 1,000 housing sites that include over 4,000 living units with a capacity for 30,000 people (Migrant Labor Housing 2022 Annual Report). Additional migrant populations exist that seasonally work within the tourism industry as well (not indicated on this map).

Amish Populations for Settlements Not Generally Driving Automobiles (Estimate, 2023)



The map does not include all Amish, and likely few Mennonites, as its data attempts to focus on communities that more fully eschew technology. Of the 18,445 estimated Amish in the state that fit these criteria, 89% are located in these colored areas. Branch County has roughly 2,500 such people, and St. Joseph 2,000. Gladwin, Mecosta, Hillsdale, and Clare also have at least 1,000. Data adapted from the Young Center for Anabaptist and Pietist Studies, Elizabethton College.

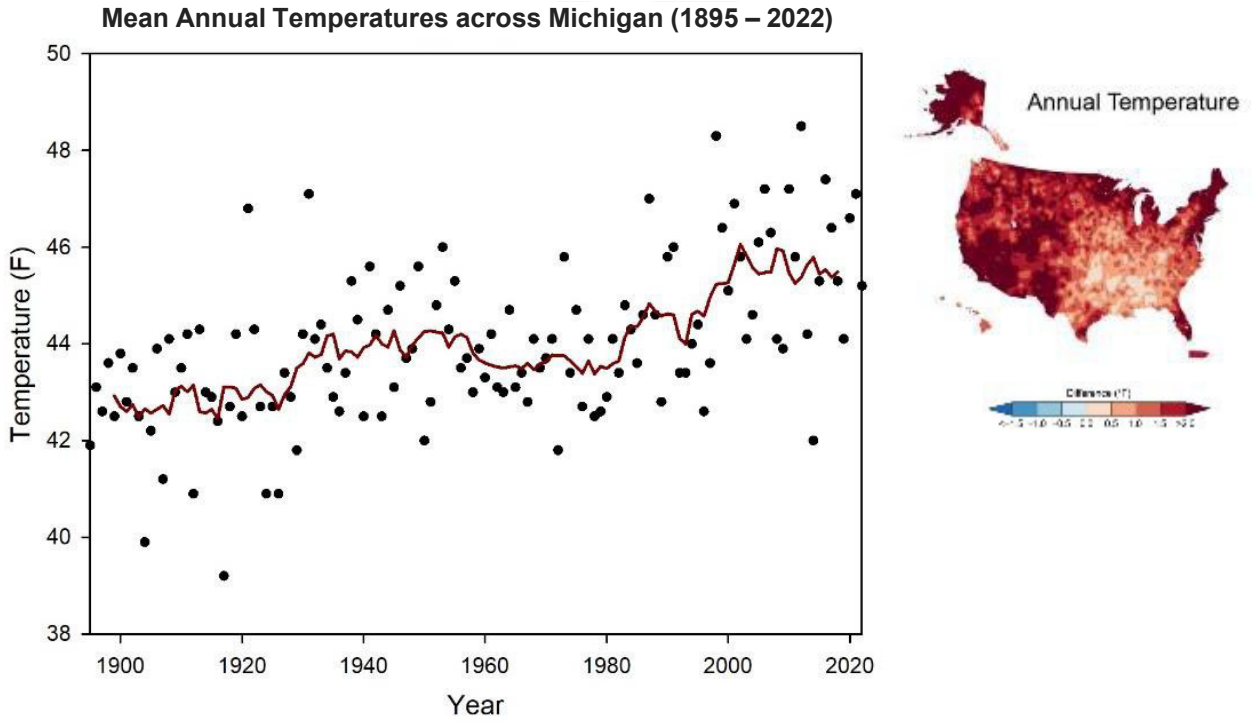
Appendix 3: Michigan Climate Trends and Considerations

As summarized in Chapter 4, many of the natural hazards impacting Michigan and the Great Lakes Region (MGLR) are weather and climate related. While the general risks of these hazards can be characterized by current scientific standards and historical occurrence, their analysis would be more straightforward if the frequency and magnitude of their underlying causal weather phenomena were static or constant over time. Unfortunately, weather and its longer-term variant, climate, is dynamic and changing due to both global and regional patterns and trends. While not predictive of future conditions, more recent observed trends reflect changes in underlying physical factors and provide a background reference to allow for a more comprehensive assessment of risk in the several year time frame typical of hazard mitigation planning. Many of the recent observed climatic changes for MGLR are consistent with those projected in future decades. It is important to note that climatic trends and changes may also be associated with a number of related impacts that have or may become more or less problematic than in the past.

Most changes described in this analysis are directly related to air temperature and precipitation, the two most commonly observed climatic variables. Major representative climate trends across MGLR are included for two major time frames: (1) current and recent historical (generally the past 50-100 years), and (2) future decades (through 2100) as projected by comprehensive simulations of the earth's climate system. Source materials are provided at the end of this appendix.

Current and Historical Trends: Temperature

The most significant and overarching global climatic trend in recent decades is a warming world. Global mean surface temperatures have risen just over 2°F since 1850 and nine of the ten warmest years on record have occurred since 2012. This warming is largely associated with increasing atmospheric greenhouse gas concentrations resulting from human activities mostly during the past 100-150 years (Lee et al., 2021). However, while mean temperatures in other regions of the world have also largely warmed during the same period, the amounts and rates of warming have differed by region, with the greatest and most rapid warming occurring at high latitudes in the middle of continents and the least over oceans in equatorial regions. Overall, mean annual temperatures in MGLR and most of the continental United States have become warmer, especially during the past 50 years.



Mean annual temperatures versus year for Michigan, 1895-2022. Individual points denote observed mean temperatures each year while the solid red line is a 9-year moving average of the individual years plotted to identify longer, decadal-scale trends over time (NOAA NCEI). A side reference map depicts average annual mean temperature changes for the present day (1992–2021) compared to the average for the first half of the last century (1901–1960) for the United States (Fifth National Climate Assessment, 2023).

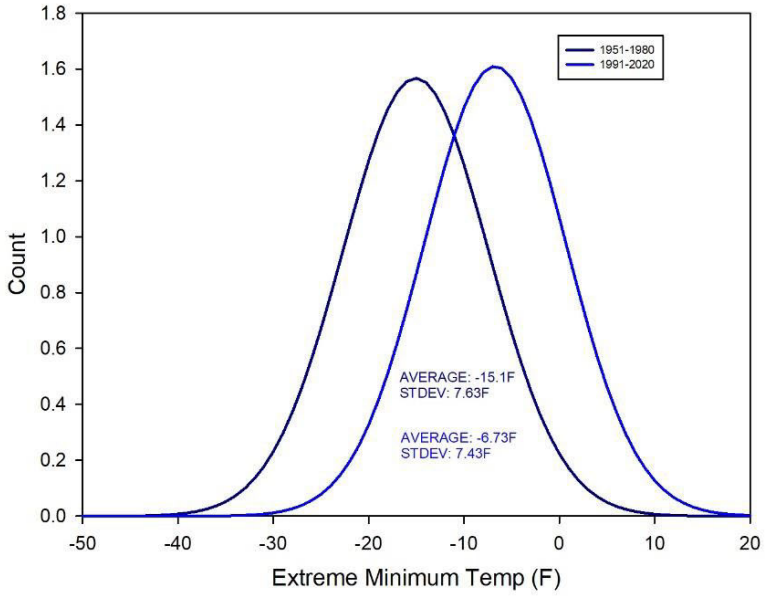
Analyzed for patterns over time, several trends result for Michigan: a general warming of just under 1°F from 1915 to about 1940, a slow cooling of about 0.5°F from 1940 to 1980, and a warming of just under 2°F from 1980 to 2005, followed by a sideways or even slight cooling trend through the present resulting in an overall warming of about 2°F

during the 128-year period. The increases in temperatures in recent decades have in general not been consistent across seasons or time of day. A relatively greater proportion of the regional warming has been associated with warmer nighttime temperatures, with changes of +0.3°F/decade for minimum temperatures versus +0.2°F/decade for maximum temperatures, which has led to an overall reduction in the diurnal range. At least some of the decrease in diurnal range has been associated with changes in the type and amount of cloud cover and is consistent with expected changes associated with increasing concentrations of greenhouse gases.

In addition, the majority of the nighttime warming has occurred during the winter and spring seasons (+0.4°F/decade and +0.3°F/decade respectively), with relatively less change in temperature found during the summer and fall seasons (+0.1°F/decade and +0.2°F/decade respectively). In sections of the Midwestern United States and portions of Michigan, mean summer temperatures have even trended cooler in recent decades, which is at least partially related to changes in land cover and land use, including the expansion of intensive agricultural production systems and their relatively higher landscape-scale water use (Alter et al., 2017).

With warming average temperatures during the year, there have also been changes in temperature related extremes, with a general warming of extreme cold minimum temperatures during all four seasons. A representative illustration of these changes for Traverse City is provided below.

Traverse City Michigan, Extreme Minimum Temperature Frequency Distributions

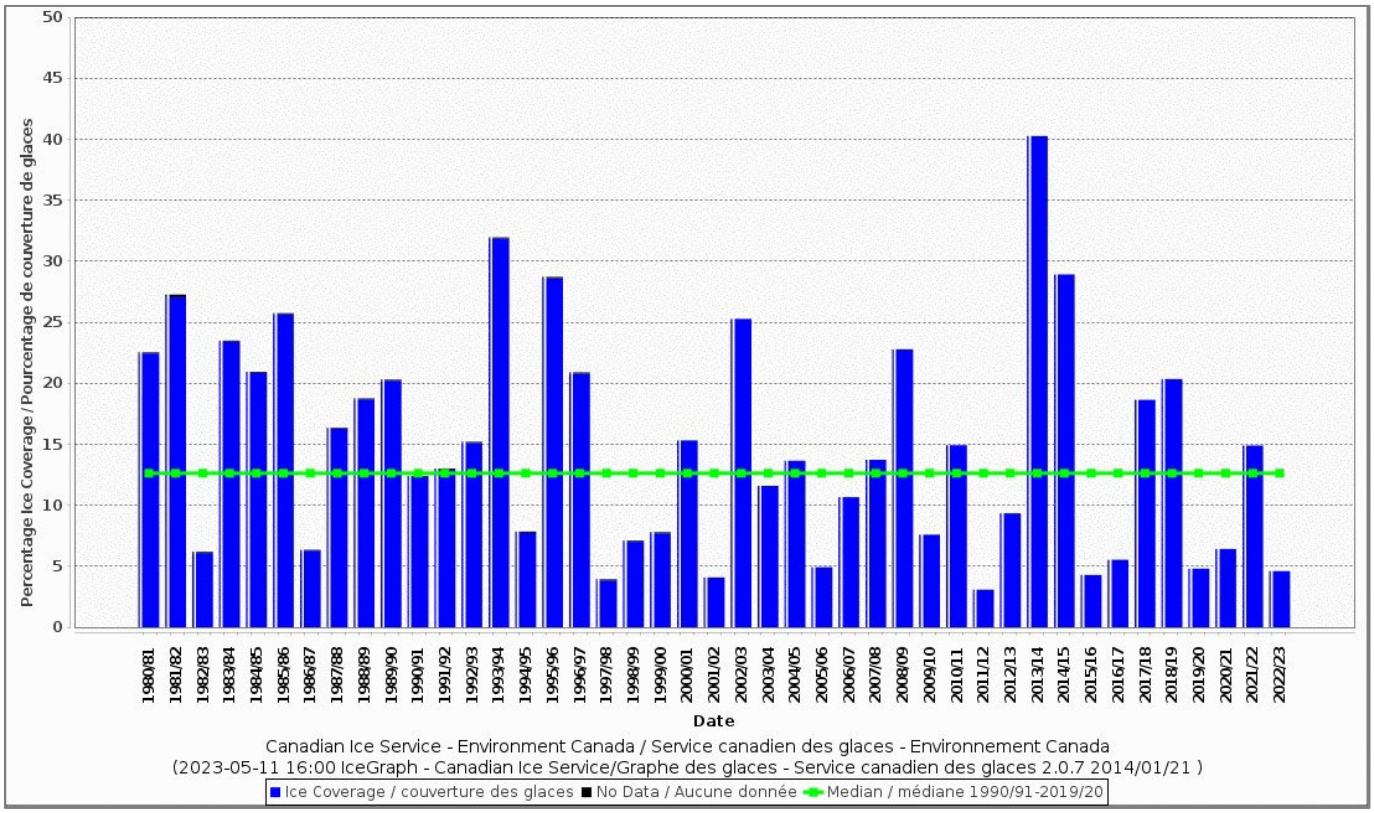


Frequency distributions of annual extreme minimum temperatures (the lowest observed minimum temperature each year) at Traverse City, Michigan, for 1951-1980 (dark blue) and 1991-2020 (light blue) periods. Mean annual temperatures versus year for Michigan, 1895-2022 (data from NOAA NCEI).

Considering two 30-year periods (30 years is the standard defined period of record length for a climate normal), 1951-1980 and the current period of 1991-2020, the mean extreme minimum temperature has increased by 8.4°F between the two periods. Also consider that the variability of these cold temperatures around the mean as expressed through the standard deviations has changed little (7.6°F versus 7.4°F), which suggests that, for at least this variable, climate change has involved a somewhat orderly shift of extremes upward as temperatures warmed.

Overall, the warming of extreme cold winter temperatures in most areas of Michigan in recent decades has led to a reduction in the number of cold-stress events. In contrast, while extreme maximum temperatures in Michigan have increased during the winter, spring, and fall seasons, they have not increased during the summer season when such extremes (and the potential for heat stress-related impacts) are highest (Wilson et al., 2023).

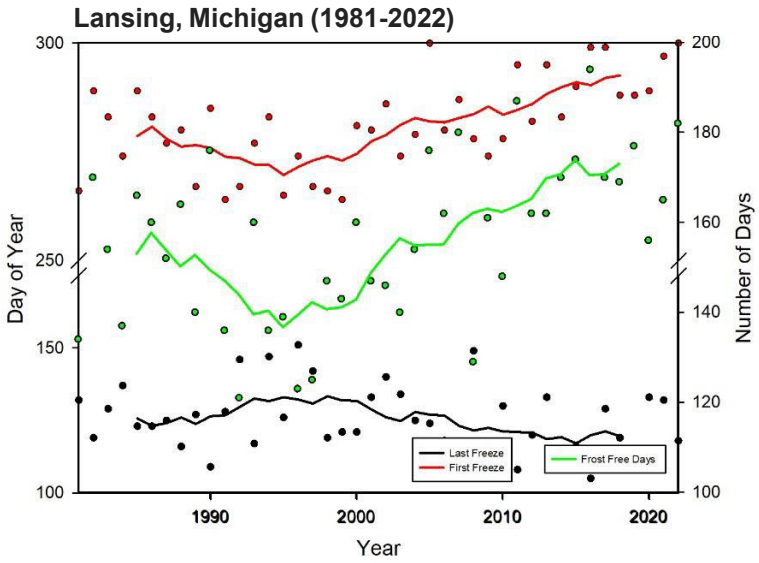
Increasing annual temperatures have also led to warming Great Lakes water temperatures since 1980, with observed increases across Lakes Superior, Michigan, Huron, and Erie (Zhong et al., 2016; Dobiesz and Lester, 2009; Austin and Colman, 2008). Milder winter temperatures have also led to decreases in the frequency and amount of ice cover on the Great Lakes. Accumulated area and duration of ice cover totaled across all of the lakes from 1980/1981 through 2022/2023 is shown on the next page.



Total ice coverage (%) on the Great Lakes, November through April, 1980/1981-2022/2023 seasons (data from Environment and Climate Change Canada, Canadian Ice Service).

Despite two of the greatest seasonal totals having occurred relatively recently in 2013/2014 and 2014/2015, the long-term trend in ice cover is downwards with a decrease of approximately 50% during the period of record. There has been an increase in interannual variability, and long-term trends in ice cover are downward.

There have also been some discernible changes in temperature seasonality, including an earlier seasonal warm up during the late winter and spring each year. A representative site in Lansing shows these changes below.

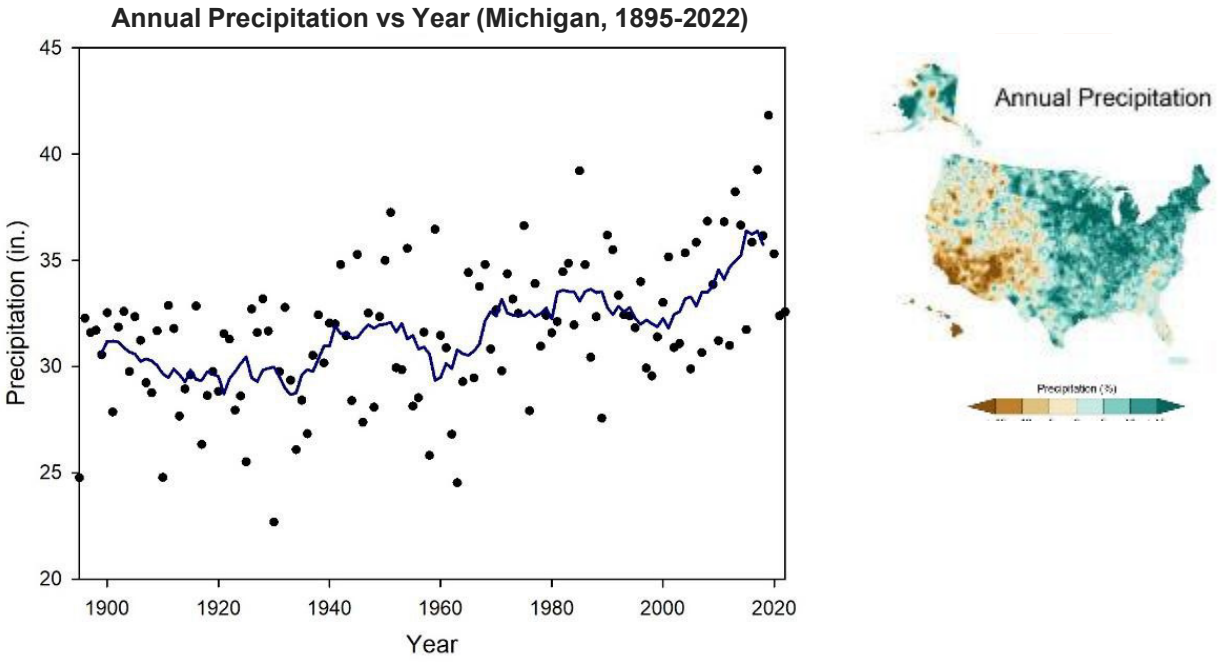


Dates of last freezing temperatures (32°F or lower) of the spring season (black), first freezing temperatures of the fall season (red), and frost-free growing season length (green) each year at Lansing, Michigan, 1980-2022. The days of the year (left y-axis, not to scale) are given in a calendar day number format (Day 1 = JAN 1, Day 2 = JAN 2, …Day 365 = DEC 31). The individual points denote observed values each year while the solid lines are 9-year moving averages of the individual years plotted to identify longer, decadal-scale trends over time (data from NOAA NCEI).

As a result, overwintering vegetation which responds directly to warming environmental temperatures is currently breaking dormancy 2-3 weeks earlier on average than it did during the middle of the last century. At the same time, the average dates of the last freezing temperatures (32°F or lower) of the spring season tend to occur at least one week earlier, while the last freezing temperatures of the fall season tend to occur at least one week later (resulting in a frost-free growing season length 2-3 weeks longer on average than was the case in the past).

Current and Historical Trends: Precipitation

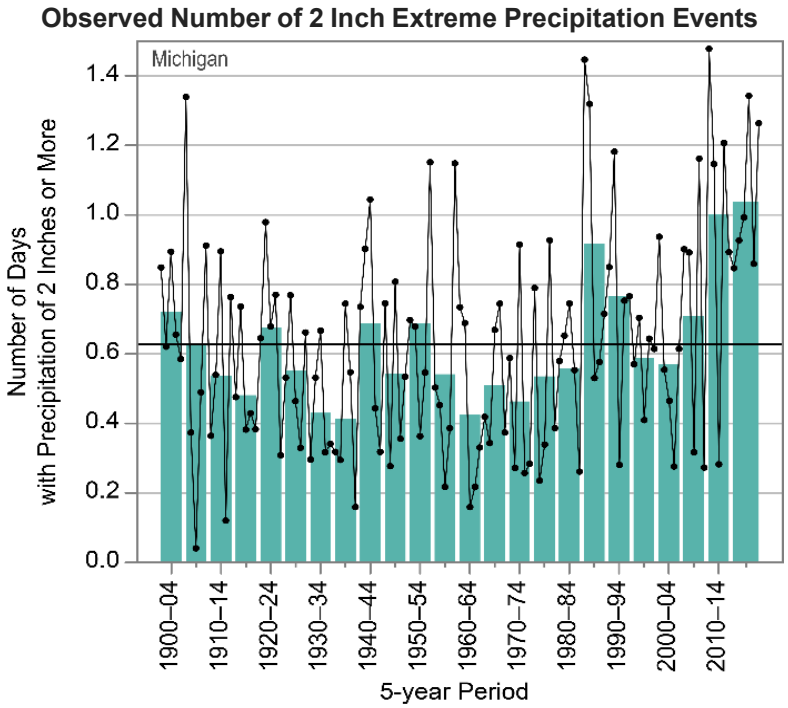
Among the most significant climatic trends and changes in MGLR over time is an increase in precipitation during much of the past century. Similar trends have been observed across much of the central and eastern United States. A graph illustrating the increase of total annual precipitation averaged across Michigan from 1895-2022 and relative changes in annual precipitation across the continental United States in recent decades is provided.



Mean annual total precipitation versus year for Michigan, 1895-2022. The individual points denote observed annual precipitation totals each year (liquid plus melted frozen water equivalent totals) while the solid blue line is a 9-year moving average of the individual years plotted to identify longer, decadal-scale trends over time (data from NOAA NCEI). A side reference map depicts average annual changes for the present day (1992–2021) compared to the average for the first half of the last century (1901–1960) for the United States (data from the US Global Change Research Program (USGCRP), 2023).

Following the overall driest period of the historical record during the 1920s and 1930s, precipitation totals in Michigan have gradually increased with time to the present, and especially during the past 30 years. The relative increase in precipitation at most sites within Michigan since the first half of last century has been 10-15% overall or about 0.42”/decade, which translates to an average addition to the annual totals of approximately 3-4” over time. There are some seasonal differences, with the greatest overall changes over the period of record from +0.14”/decade during the fall and +0.13”/decade during the summer to +0.06”/decade during the winter. It is also important to note that changes in more recent decades have been relatively larger. Considering the period from 1951-2022, the mean annual change was
+0.62”/decade, with seasonal changes of +0.23”/decade, +0.16”/decade, +0.16”/decade, and +0.08”/decade for fall, winter, spring, and summer seasons respectively.

The increases in precipitation over time across the region have been associated with both increases in the amount of precipitation per event and increases in the number of precipitation events. Since the 1950s, there has been an upward trend in heavy precipitation events across the United States, driven largely by more frequent precipitation extremes, with relatively smaller changes in their intensity (Kunkel et al. 2020a). An example of the increasing frequency of heavy precipitation events is provided on the next page, which depicts annual numbers of 2” or greater daily precipitation on average across Michigan from 1900-2020. From the 5-year average values, the frequency of these events almost doubled from the 1960s through the last decade. Collectively across the Midwest region (including Michigan), total precipitation falling on the heaviest 1% of days, daily maximum precipitation in a 5-year period, and the annual heaviest daily precipitation amount have increased 45%, 11%, and 10% respectively during the 1958–2021 period (USGCRP, 2023). These changes have contributed to increases in river and stream flooding in these regions with several major impactful events during the past decade (e.g., August 2014 SE Lower Michigan event, June 2018 Keweenaw event).



Observed number of 2 inches or greater daily precipitation events across Michigan versus year, 1900-2020. The individual points denote annual values and bars show averages over 5-year periods (the last bar is a 6-year average). The horizontal black line shows the long-term (entire period) average of 0.6 days (data from Frankson et al., 2022).

Although reliable data on snowfall and snow cover are less readily available, there are some notable observed trends across MGLR. In general, seasonal snowfall totals have tended to remain level or decline slightly with time during the past 30 years across central and southern sections of the region (including southern sections of Michigan) while increasing across areas where lake effect precipitation is common such as northwestern Lower and northern Upper Michigan. These changes are thought to be both because of decreases in snowfall associated with synoptic low-pressure systems moving through the region in which relatively more of the precipitation is falling as rain instead of snow (Feng and Hu, 2007) and to increases in snowfall associated with enhanced lake effect processes due to warmer lake water temperatures and declining ice cover on the lakes (Wilson et al., 2023). Even in areas with snowfall increases, there have also been observed increases in interannual variability of seasonal totals. In addition, there is observational evidence that the overall length of time with snow cover is now decreasing in many areas as snow melts more quickly due to increased temperatures during the cold season.

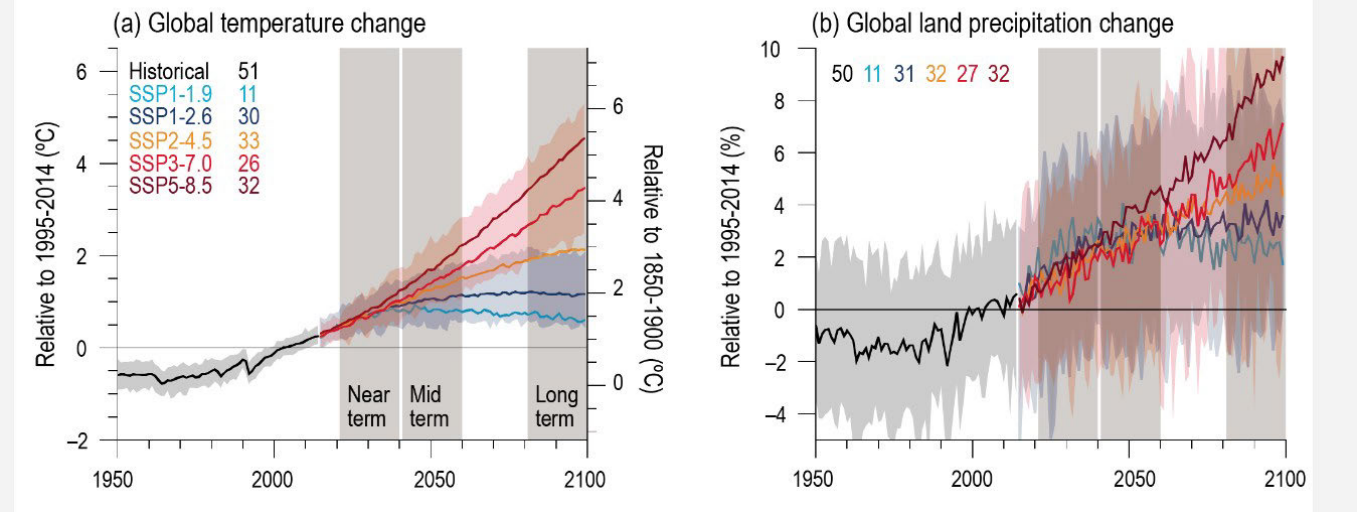
Given the overall increases in precipitation in Michigan, the frequency and severity of drought in the state have generally decreased with time during recent decades. In a study of hydrologic trends in Michigan during the past century, Andresen et al. (2009) found precipitation increases observed across the state during the late 1930s through the late 1990s were associated with increases in evapotranspiration, runoff, and shallow groundwater recharge. Their results suggested that the majority of the additional precipitation across the MGLR during the past few decades has ended up as groundwater recharge. However, intense drought continues as a risk as witnessed during the 2012 summer drought across much of the Midwest. Drought is also associated with changes in atmospheric demand for water or potential evapotranspiration. When potential evapotranspiration occurs at elevated levels for extended periods, Michigan is vulnerable to rapid onset "flash droughts" that can materialize in a matter of days, driven by extremely high temperatures and wind speeds with a lack of rainfall (Otkin et al. 2022). In contrast to large scale hydrologic droughts driven primarily by extended precipitation deficits which have been decreasing over time, the frequency of shorter-term flash droughts has increased across the region in recent decades. For example, flash drought conditions that developed rapidly in Michigan during the spring of 2023 resulted in adverse agricultural impacts but then ended abruptly following abnormally heavy late summer rainfall and flooding (amid above normal long term precipitation totals).

The combined influence of increasing precipitation and air and water temperatures, loss of ice cover, and changes in lake evaporation, have also led to changes in Great Lakes water levels over the past few decades, highlighted by a rapid increase from abnormally low water levels from 1998 to 2013 to abnormally high-water levels from 2015-2021 (Gronewold et al. 2021). The increases in variability have complicated water management of the Great Lakes system in applications ranging from hydroelectric power generation to shipping to shoreline erosion. There have also been ecological changes including species population changes, invasive species, and aquatic ecosystem habitat quality (McKenna, 2019).

Projected Future Trends

Projections of future climate conditions are based on complex physical simulations of the Earth's atmosphere, its circulation, and interactions with the oceans and biosphere. Because of their deterministic design, the simulations are able to determine the potential impacts of changes in historical and potential future global greenhouse gas (GHG) emissions, including carbon dioxide (CO2), and are considered the best and most comprehensive estimates of future climate conditions. The outcomes of the simulations are heavily dependent on the rate and size of future GHG emissions. In order to obtain a number of possible and plausible climate outcomes, a diverse set of five emissions scenarios, or Shared Socioeconomic Pathways (SSP), was considered in the most recent collaborative effort of the Intergovernmental Panel on Climate Change (IPCC) in its Coupled Model Intercomparison Project 6: SSP1-1.9, SSP1-2.6, SSP2-4.5, SSP3-7.0, and SSP5-8.517 (ICC, 2021). These five scenarios included those with high and very high GHG emissions and CO2 emissions that roughly double from current levels by 2100 and 2050 (respectively), a scenario with intermediate GHG emissions and CO2 emissions remaining around current levels until the middle of the century, and scenarios with very low and low GHG emissions and CO2 emissions declining to net zero around or after 2050 (followed by varying levels of net negative CO2 emissions). Changes projected by the simulations are assessed relative to both the recent past (1995–2014) and the 1850–1900 approximation to the pre-industrial period (IPCC, 2021a).

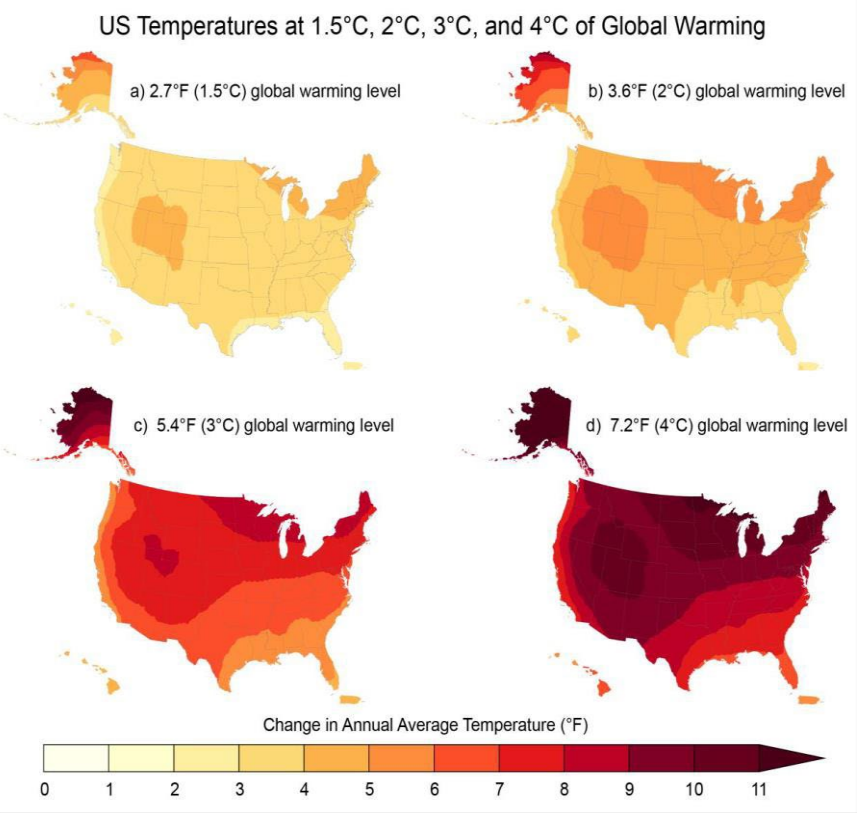
A graphical summary of global climate projections for mean annual temperatures and total annual precipitation for the various emissions scenarios over land areas from 1851-2100 is provided below.



Historical and projected future changes in (a) Global surface air temperature changes (°C) relative to the 1995–2014 average (left axis) and the 1850–1900 average (right axis). The 1850-1900 average is offset by 0.82°C, which is the multi-model mean and close to observed best estimate; and (b) Global land precipitation changes relative to the 1995–2014 average. The projections are based on averages of Coupled Model Intercomparison Project 6 climate model simulations for five separate Shared Socioeconomic Pathway scenarios SSP 1-2.6 through SSP5-8.5 depicting a low to high range of emissions scenarios (IPCC, 2021a).

The numbers of individual climate model simulations are listed next to the emission scenarios. For each emission scenario, the median of the simulations is given as a solid-colored line which the overall range is depicted in a lighter tone of the same color. The magnitude and speed of projected changes of both global average temperature and precipitation are closely associated with GHG emissions, with relatively greater and more rapid increases with the highest emission scenarios and vice versa. Compared to the 1850-1900 period, average global surface temperatures for the period 2081-2100 are very likely to increase from a range of 1.0°C to 1.8°C (1.8°F to 3.2°F) in the low GHG emissions scenario SSP1-1.9 to 3.3°C to 5.7°C (5.9°F to 10.3°F) in the high GHG emissions scenario SSP5-8.5. In all scenarios assessed except for SSP5-8.5, the central timing estimate of 20-year averaged global surface warming crossing the 1.5°C (2.7°F) level occurs in the early 2030s. Global surface temperatures are projected to continue to increase until at least mid-century under all emissions scenarios considered. Global warming of 1.5°C (2.7°F) and 2°C (3.6°F) will be exceeded during the 21st century unless deep reductions in CO2 and other GHG emissions occur in the coming decades. By late this century (2081–2100), global mean temperatures rises compared to 1850–1900 are projected to increase by 1.0°C to 1.8°C (1.8°F to 3.2°F) under the very low GHG emissions scenario (SSP1-1.9), by 2.1°C to 3.5°C (3.8°F to 5.3°F) in the intermediate GHG emissions scenario (SSP2-4.5) and by 3.3°C to 5.7°C (5.9°F to 10.3°F) under the very high GHG emissions scenario (SSP5-8.5). Given current GHG emission levels and future conformance to existing international GHG mitigation commitments, a most likely scenario of a 2.5-2.9°C global temperature rise above pre-industrial levels has been projected (UNEP, 2023).

The most recent IPCC Sixth Assessment Report (AR6, IPCC 2021b) projected geographical changes in climate are for given global warming levels of 1.0°C (1.8°F), 1.5°C (2.7°F), 2.0°C (3.6°F), 3.0°C (5.4°F) and 4.0°C (7.2°F) relative to 1850–1900 conditions. For many climate variables the regional response patterns for a given global warming level are consistent across different scenarios, as was the case for the Midwestern United States in which projected warming in the region is consistently greater than the global averages. Projected regional changes in mean annual temperature for the United States given 1.5°C, 2.0°C, 3.0°C, and 4.0°C global increases relative to the period 1851-1900 are shown.

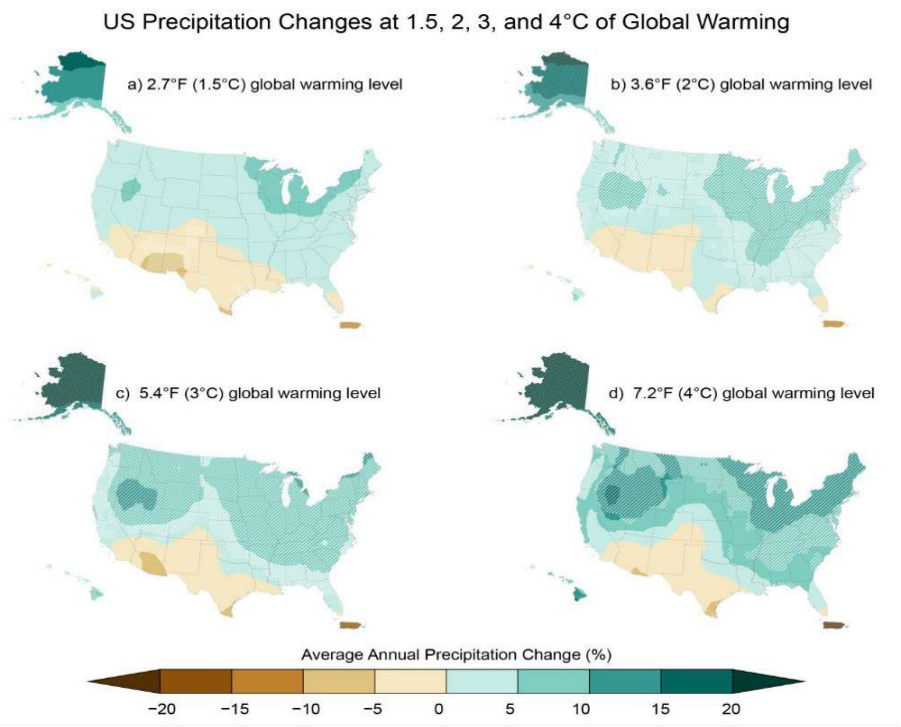


Projected changes in mean annual temperature for the United States given 1.5°C, 2.0°C, 3.0°C, and 4.0°C global increases relative to the period 1851-1900. The projections are based on averages of Coupled Model Intercomparison Project 6 climate model simulations for five separate Shared Socioeconomic Pathway scenarios SSP 1-2.6 through SSP5-8.5 depicting a low to high range of emissions scenarios. Figure credit: NOAA NCEI and the Cooperative Institute for Satellite Earth System Studies (CISESS)).

The projections are based on averages of Coupled Model Intercomparison Project 6 climate model simulations for five separate Shared Socioeconomic Pathway scenarios, SSP 1-2.6 through SSP5-8.5, depicting a low to high range of emissions scenarios (NOAA NCEI and CISESS NC). Projected average warming by the late century (2091-2100) for MGLR ranges from 3°F to 5°F for the global 1.5°C warming level to 9°F to 11°F in the global 4°C warming level.

Projected regional changes in mean total annual precipitation for the United States given 1.5°C, 2.0°C, 3.0°C, and 4.0°C global increases relative to the period 1851–1900 are shown on the next page. Those findings generally show that precipitation in the United States is projected to increase with warming in the North and East and to decrease in the Southwest. For MGLR, annual precipitation is expected to increase as temperatures warm globally, with general increases of 5-10% for temperature increases up to 3°C and from 10-15% for warming of 4°C. Some seasonal changes are also expected including an increasing fraction of annual precipitation falling as rain (instead of snow) and an earlier melt of seasonal snowpack (Marvel et al., 2023).

The projections also consistently suggest future increases in extreme precipitation events across the region, linked most strongly with increases in atmospheric water vapor content as the climate warms. As a result, extreme precipitation events are projected to become more frequent with time, with relatively greater increases for rare events (i.e., a 50-year return period) versus less rare events (i.e., a 1-year return period).



Projected changes in mean annual precipitation (%) for various global warming levels (1.5°C, 2.0°C, 3.0°C, and 4.0°C) relative to the period 1851-1900. The projections are based on averages of Coupled Model Intercomparison Project 6 climate model simulations for five separate Shared Socioeconomic Pathway scenarios SSP 1-2.6 through SSP5-8.5 depicting a low to high range of emissions scenarios. Hatching indicates areas where 80% or more of the models agree on the sign of the change. Figure credit: Project Drawdown, Stripe Inc., NOAA NCEI, and CISESS.

From a recent comprehensive study of heavy precipitation events and their major causal meteorological factors, Kunkel et al. (2020b) projected general increases in 24-hour and 3-day extreme event totals in Michigan from 14-22% for the 2070-2099 versus 1976-2005 period under a high GHG emission scenario (RCP 8.5) under CMIP 5 simulations, with relatively higher increases in 100-year recurrence vs shorter terms. For example, 24-hour heavy precipitation events at Lansing, MI for 2-, 10-, 50-, and 100-year recurrence intervals are currently estimated by NOAA Atlas 14 at 2.43", 3.42", 4.80", and 5.50", respectively. The projected values for 2070-2099 period are 2.98", 4.26", 6.08", and 6.99" respectively. Overall, the research suggests that future changes in return-period threshold values will increase with increasing return periods with larger future changes increase associated with larger GHG forcing and that the projected changes over space are relatively small compared to the magnitude of the changes over time (Kunkel et al., 2020b).

A major fraction of the most impactful weather events in Michigan are associated with severe thunderstorms and tornadoes, including 36 of the 53 confirmed events with $1 billion or greater economic losses since 1980 (NOAA NCEI, 2023). While there is relatively less confidence in future projections of their frequency and severity in the future than for other climatic variables (NAS, 2016), a warming climate is expected to provide at least the potential for stronger storms (Prein, 2023), and with higher levels of atmospheric water vapor and heavier precipitation. Very recent research suggests that severe weather events overall in the United States will become more frequent with a longer storm season and a possible seasonal shift in frequency from midsummer and early autumn to late winter and early spring (Ashley et al, 2023; Haberlie et al. 2022).

Collectively, these recently observed trends and future projections suggest a warmer and wetter climate trajectory for MGLR. Adaptation (i.e., hazard mitigation) to these environmental changes will be necessary. These trends have already resulted in and are likely to cause an increasing number and wide variety of related regional impacts and effects in the future, ranging from heavy rain events and associated flooding risks to changing agricultural productivity to changes and shifts of natural ecosystems to new human health risks (EPA, 2016). The economic impact on select regions that rely on winter tourism from snow and ice related activities may be substantial.

The projections suggest that the faster and more extensive the warming in the future, the greater the risk of climate impacts overtaking the speed of adaptation which in turn suggests that society will need to adapt to a changing climate regardless of the rates of future GHG emissions.

Climate Migration

The frequency and severity of weather and climate-related impacts in the coming decades are expected to vary significantly across the United States and the world as a whole. Given this, and the expectation that impacts in some areas will be less severe and possibly even positive, there is an increasing expectation that people will migrate from areas of high risk and vulnerability to other areas where the climate is less stressful (a concept referred to as climate migration). Based on very recent research, more than 216 million people around the world could be forced to move due to climate change by 2050, with sea level rise as a primary concern (Robinson et al., 2020; Clement et al., 2021). Michigan, with a major supply of fresh water away from oceans and a relatively cooler, less stressful climate, may become an attractive option. While the emergence of any climate migration into the state carries many uncertainties, communities should consider its potential during future panning efforts (Van Berkel et al., 2022).

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Appendix 4: Program Implementation

The programs referenced in Chapter 5 represent core aspects of capabilities related to MSP/EMHSD and hazard mitigation. Summaries of their implementation and use is one way to demonstrate these capabilities. This appendix is divided into the following sections:

Section 1: Program Implementation Summary
Section 2: Program and Project Examples
Section 3: Program Commentary

Section 1: Program Implementation Summary

The following summary graphic includes program projects from as early as 1994. Newer programs (e.g., BRIC) have a shorter period of demonstrated implementation. The RFC Program is included below but no longer exists as an independent grant, having been incorporated into FMA.

Summary of Implemented Hazard Projects and Planning Grants by Program

Building Resilient Infrastructure and Communities (BRIC) Program Projects
Planning, Capability and Capacity Building, and Project Grants
Awarded During Fiscal Years 2020-2022

Hazard Mitigation Grant Program (HMGP) Projects
Federal Disaster #1028: 1994 Northern Michigan Deep Freeze
Federal Disaster #1128: 1996 East Michigan Tornado and Flooding
Federal Disaster #1181: 1997 Southeast Michigan Tornadoes and Flooding
Federal Disaster #1226: 1998 West Michigan Windstorm
Federal Disaster #1237: 1998 Detroit Area Windstorm
Federal Disaster #1346: 2000 Detroit Area Urban Flooding
Federal Disaster #1413: 2002 Central and Western Upper Peninsula Flooding
Federal Disaster #1527: 2004 Southern Michigan Severe Storms and Flooding
Federal Disaster #1777: 2008 Central Michigan Severe Storms and Flooding
Federal Disaster #4121: 2013 Central Michigan and Western Upper Peninsula Flooding
Federal Disaster #4195: 2014 Detroit Area Urban Flooding
Federal Disaster #4326: 2017 Central Lower Michigan Flooding
Federal Disaster #4381: 2018 Central Upper Peninsula Flooding
Federal Disaster #4494: 2020 Statewide COVID-19 Disaster
Federal Disaster #4547: 2020 Central Lower Michigan Flooding
Federal Disaster #4607: 2021 Detroit Area Flooding and Central Michigan Tornadoes

Flood Mitigation Assistance (FMA) Program Projects
Planning, Technical Assistance, and Project Grants
Awarded During Fiscal Years 1996-2015

Pre-Disaster Mitigation Program (PDM) Projects
PDMP Planning and Project Grants
Awarded During Fiscal Years 2002-2023

Repetitive Flood Claims (RFC) Program Projects
RFC Project Grants
Awarded During Fiscal Year 2006 and 2012

(source: MSP/EMHSD)

The following table provides a breakdown of the programs that have been utilized in Michigan, as well as their funding. Totals in theses tables represent 505 separate grants/projects. Of these projects, 435 are complete and the totals included in the tables are based on actual project costs ($106,561,090 in completed grant costs). The remaining 70 grants have been awarded and are being implemented but are not yet complete. For these grants, projected totals were used based on grant application budgets.

MITIGATION PROJECT FUNDING MADE AVAILABLE IN MICHIGAN SINCE 1994, BY HMA FUNDING PROGRAM (AS OF NOVEMBER 2023)

Program	Number of Projects	Projects Total Cost	Federal Share	Local Match
BRIC	10	$1,941,148.56	$1,490,561.12	$450,587.44
FMA	33	$1,595,418.44	$1,343,797.46	$251,620.98
HMGP	363	$139,324,224.80	$107,494,273.22	$31,829,969.37
PDM	97	$28,291,958.93	$20,669,299.22	$7,622,659.70
RFC	2	$224,959.46	$224,959.46	$0.00
Grand Total	505	$171,377,710.19	$131,222,890.47	$40,154,837.49

The following table provides a breakdown by project type, as well by funding for federal share and local match.

MITIGATION PROJECT FUNDING MADE AVAILABLE IN MICHIGAN SINCE 1994, BY PROJECT TYPE (AS OF NOVEMBER 2023)

Type of Project	Number of Project	Projects Total Cost	Federal Share	Local Match
Acquisition	54	$33,929,514.36	$27,463,360.26	$6,466,172.11
Culvert Upgrade	23	$4,487,518.37	$2,981,739.36	$1,505,779.01
Detention / Retention Basin	6	$2,633,926.19	$1,848,646.64	$785,279.55
Early Warning	74	$3,494,950.94	$2,467,245.14	$1,027,705.80
Erosion Stabilization	20	$11,145,387.60	$7,877,291.79	$3,268,095.81
Flood Control	16	$35,235,109.09	$27,249,216.15	$7,985,892.94
Generator	16	$3,711,149.64	$2,085,913.83	$1,625,235.81
Home Elevation	21	$6,316,639.64	$4,790,164.39	$1,526,475.25
Management Costs	27	$8,327,378.30	$7,663,015.74	$664,362.56
Miscellaneous	32	$3,943,934.10	$2,726,391.31	$1,217,542.69
Hazard Mitigation Plan	129	$8,603,020.08	$6,271,638.44	$2,331,381.63
Safe Room	10	$9,691,487.85	$7,364,866.17	$2,326,621.68
Stormwater Improvement	43	$31,705,724.26	$23,890,192.79	$7,815,531.36
Water and Sewer Freeze Mitigation	20	$1,798,536.63	$1,073,658.00	$724,878.63
Wind Retrofit Mitigation	5	$357,139.14	$266,172.31	$90,966.83
Project Scoping	9	$5,996,294.01	$5,203,378.16	$792,915.85
Grand Total	505	$171,377,710.19	$131,222,890.47	$40,154,837.49

The final table (next page) provides a breakdown by county. For grants that benefited multiple counties, the project totals were evenly distributed to the counties they benefitted. A total of 37 grants yielded statewide benefits, and those are totaled under the category of “statewide” within the table. All grants, other than totaled in the statewide category, were passed through from the State of Michigan to local units of government, tribes, or state agencies.

MITIGATION PROJECT FUNDING MADE AVAILABLE IN MICHIGAN SINCE 1994, BY COUNTY (AS OF NOVEMBER 2023)

County	Project Total	Federal Share
Alcona	$358,662	$224,581
Alger	$56,494	$41,668
Allegan	$8,843,491	$6,618,799
Alpena	$627,210	$411,669
Antrim	$513,879	$336,032
Arenac	$291,041	$184,850
Baraga	$135,662	$99,098
Barry	$375,732	$280,616
Bay	$3,994,737	$3,253,999
Benzie	$162,276	$121,705
Berrien	$73,010	$53,637
Branch	$0	$0
Calhoun	$168,043	$135,353
Cass	$101,116	$74,136
Charlevoix	$513,308	$362,002
Cheboygan	$64,010	$47,672
Chippewa	$624,533	$468,413
Clare	$2,317,344	$1,738,846
Clinton	$899,070	$674,358
Crawford	$62,637	$46,056
Delta	$69,069	$51,100
Dickinson	$117,006	$87,359
Eaton	$434,301	$310,717
Emmet	$223,684	$116,983
Genesee	$5,616,131	$4,206,669
Gladwin	$120,181	$99,523
Gogebic	$672,164	$378,281
Grand Traverse	$1,955,996	$1,464,497
Gratiot	$473,007	$318,853
Hillsdale	$55,407	$26,634
Houghton	$1,467,867	$1,112,839
Huron	$663,392	$430,966
Ingham	$1,854,122	$1,367,192
Ionia	$452,500	$341,372
Iosco	$275,190	$167,315
Iron	$266,785	$191,586
Isabella	$2,022,237	$1,395,778
Jackson	$200,578	$131,582
Kalamazoo	$4,534,337	$2,732,115
Kalkaska	$66,368	$49,774
Kent	$9,180,848	$7,022,140
Keweenaw	$207,613	$155,343
Lake	$187,184	$139,313
Lapeer	$103,172	$77,111
Leelanau	$88,343	$63,649
Lenawee	$256,226	$177,220
Livingston	$674,605	$459,067
Luce	$57,881	$43,424

County	Project Total	Federal Share
Mackinac	$496,863	$333,142
Macomb	$5,841,300	$3,811,901
Manistee	$66,368	$49,774
Marquette	$4,076,596	$2,766,992
Mason	$684,323	$510,917
Mecosta	$123,094	$123,094
Menominee	$56,494	$41,668
Midland	$6,649,408	$5,979,227
Missaukee	$66,368	$49,774
Monroe	$5,265,320	$4,010,760
Montcalm	$25,455	$25,455
Montmorency	$60,670	$44,581
Muskegon	$490,713	$367,914
Newaygo	$336,646	$250,619
Oakland	$20,878,891	$17,594,440
Oceana	$159,244	$119,313
Ogemaw	$294,056	$217,639
Ontonagon	$121,772	$91,223
Osceola	$40,668	$32,727
Oscoda	$60,670	$44,581
Otsego	$62,776	$46,156
Ottawa	$4,347,912	$3,117,035
Presque Isle	$757,286	$567,043
Roscommon	$925,734	$695,167
Saginaw	$4,914,812	$3,304,488
Sanilac	$708,360	$439,796
Schoolcraft	$56,494	$41,668
Shiawassee	$273,015	$218,569
St. Clair	$1,384,799	$1,026,925
St. Joseph	$327,175	$245,381
Statewide	$9,130,544	$8,231,312
Tuscola	$4,138,550	$2,680,040
Van Buren	$687,672	$455,050
Washtenaw	$8,248,122	$6,216,372
Wayne	$36,056,125	$28,367,936
Wexford	$912,799	$684,597
Tribal	$172,171	$127,727
State of Michigan Totals:	**$171,377,710**	**$131,222,890**

Section 2: Program and Project Examples

This section contains a selection of successful HMA funded projects completed throughout Michigan over the past 30 years. They can provide local, county, and state agencies with examples of implemented projects that have successfully reduced a community's vulnerability to common natural hazards in cost-effective ways through both small and large-scale implementation.

The following representative samples include projects from several programs being used for a variety of hazard mitigation purposes, which are listed at the top of each page.

Additional information includes where the project was completed, the year(s) it was completed, and subrecipient name. Disadvantaged communities are identified based on the BRIC Fiscal Year 2022 Notice of Funding Opportunity document, with qualifying communities having a CDC SVI of .6 or higher.

A leaf symbol designates that the project contained a component considered to be a nature-based solution. 

Twenty-three examples are provided in three primary categories. These are included in an order that follows those that deal with (1) direct flooding mitigation, (2) geologic mitigation (e.g., erosion, subsidence), and lastly (3) extreme weather (e.g., tornadoes, high winds).

Broken down further, those dealing with:

- Flooding includes examples related to property acquisition, culvert upgrades, detention and retention basins, flood warning systems, utility protection, and structural elevation.
- Geologic mitigation includes examples related to streambank stabilization, dunes, and utility relocation.
- Extreme weather includes early warning sirens, generators, powerline burial, and community safe rooms.

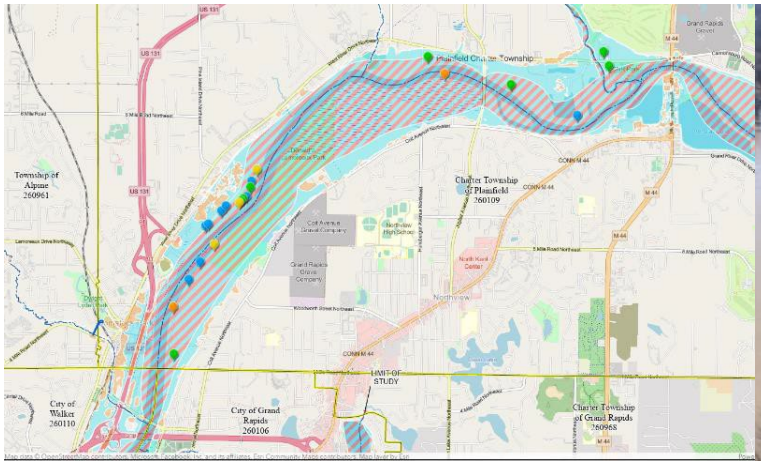
The content for the summaries comes from a variety of sources, including from project applications, project closeout reports, correspondence messages with subrecipients, FEMA's NRI, MSP/EMHSD, NWS, and ArcGIS. It is planned for more projects to be summarized and then compiled into its own stand-alone publication.

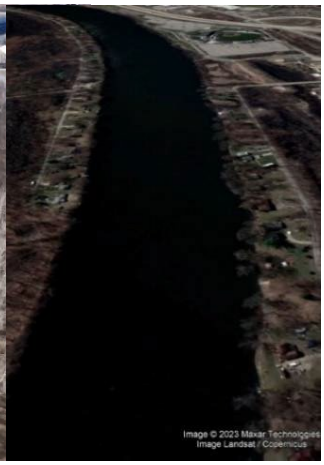
The examples begin on the next page, formatted as one per page for consistency. Additional project examples in other states are highlighted by FEMA in their Mitigation Action Portfolio, which can be found as part of the BRIC Resources webpage found HERE.

Years Completed: 2012, 2013, 2014,2017.
Hazard Vulnerability: Floods
Mitigation Project Type: Acquisitions
Funding Source: HMGP 1777 (9 properties), PDM 2011 (3 properties), FMA-2009 (2 properties), HMGP 4121 (8 properties).

County: Kent
Subrecipient: Plainfield Charter Township
Location: Belmont, Comstock Park, Grand Rapids
Disadvantaged Community: No

Pre-mitigation Post-mitigation





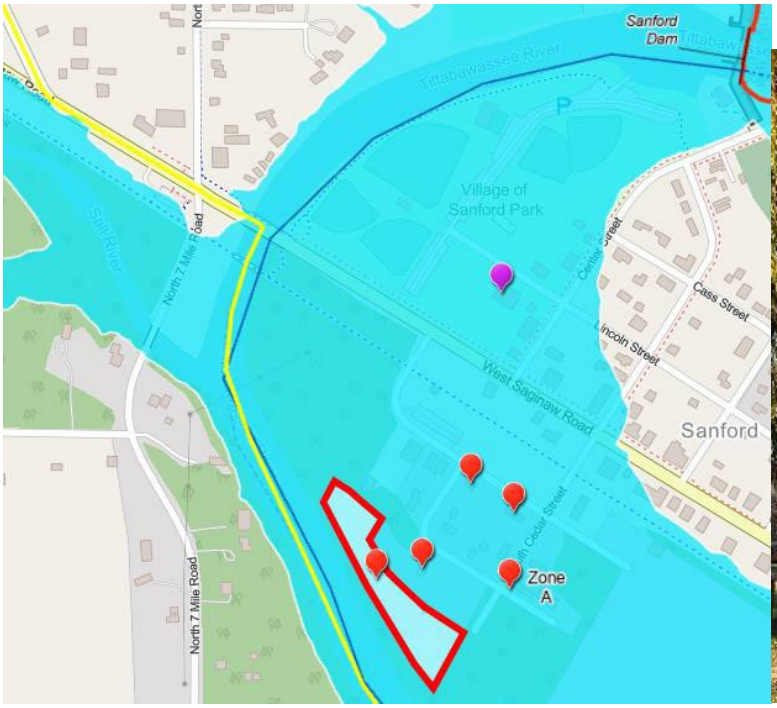
Total Cost: $1,474,513.83 **Total Federal Share:** $1,105,885.39 **Non-federal Share:** $368,628.44
Cost Effectiveness Method: Precalculated Benefits **Estimated Annual Benefit:** $71,060

Scope of Work Summary: Plainfield Township has purchased 22 flood prone properties along the Grand River within the Township. The projects included the purchase of the properties; removal of all structures; and registering properties with FEMA's open space deed restriction. The Deed Restriction requires the property parcels to be reverted to natural floodplain and/or inclusion as part of an open space park area in perpetuity. Demolition activities occurred in previously disturbed areas in absence of high water. No equipment was staged or entered the Grand River as part of the projects. All demolition materials were properly disposed of in an approved landfill. All acquired properties are located within a special floodplain hazard area.

These properties have experienced 15 flooding events that would have resulted in at least minor flooding of basements since the first property was acquired in 2013. Three were major flooding events that would have caused substantial damage. The highest flooding event, 17.8 ft on 4/12/2013 (DR-4121), occurred less than one month after the first property was acquired.

Years Completed: 2019, 2022
Hazard Vulnerability: Floods
Mitigation Project Type: Property Acquisitions
Funding Source: HMGP 4195 (1 property), HMGP 4326 (5 properties).

County: Midland,
Subrecipient: Village of Sanford
Location: Village of Sanford
Disadvantaged Community: No



Post-mitigation

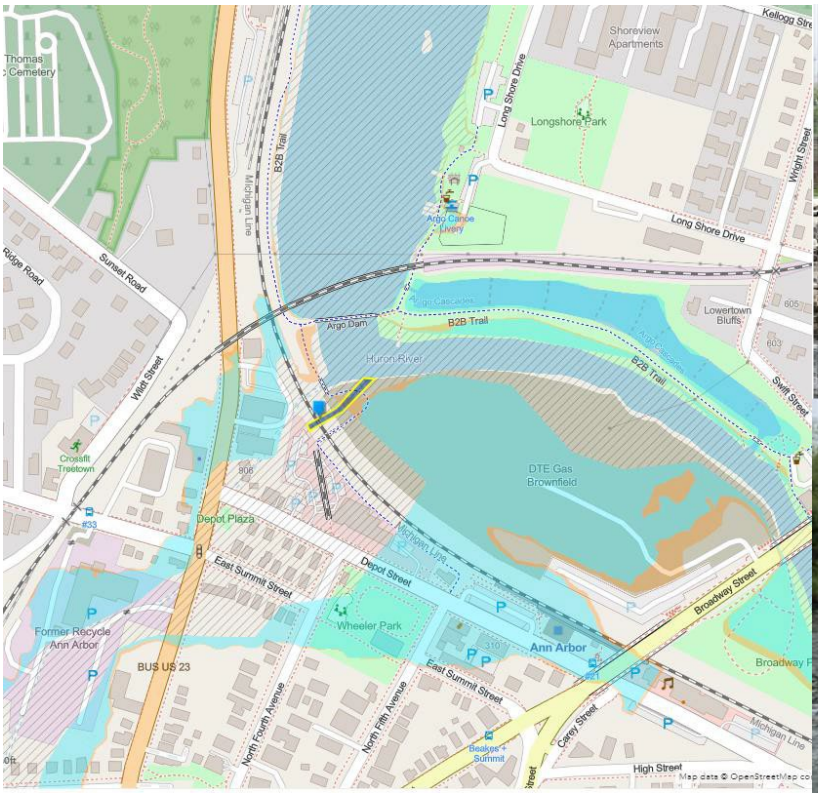
Total Cost: $304,353.71 **Total Federal Share:** $227,962.98 **Non-federal Share:** $76,390.73
Cost Effectiveness Method: Precalculated Benefits **Estimated Annual Benefit:** $18,300

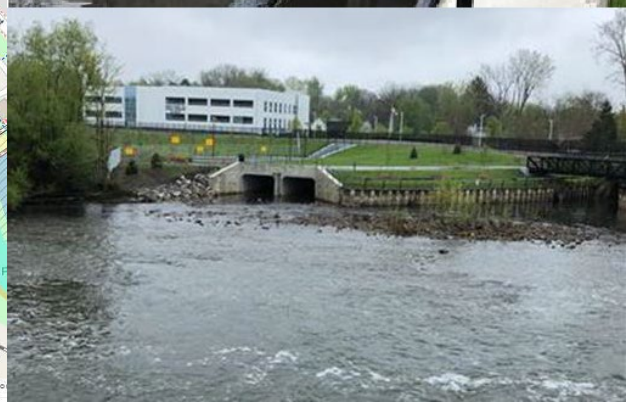
Scope of Work Summary: The Village of Sanford has acquired eight flood prone properties along the Tittabawassee River below the Sanford Dam. The projects included the purchase of the properties and removal of any structures. Participating properties were deeded as open space in perpetuity and were reverted to natural floodplain and/or became or will be included as part of open space park area, Porte Park. Demolition activities occurred in previously disturbed areas in absence of high water. No equipment was staged or entered the Tittabawassee River as part of projects. All demolition materials were properly disposed of in an approved land fill. The acquired properties are located within a special floodplain hazard area.

Structures on each property were severely damaged or destroying prior to demolition by flooding disasters DR-4326 and DR-4547. The property owner of the senior center building that participated in the HMGP 4195 project decided to donate instead of selling the building to the Village after it suffered severe damage in the 2017 DR-4326 flood. The breach and failure of the Sanford Dam, DR-4547, swept many homes off their foundations and resulted in three homeowners withdrawing from the project since they received flood insurance property replacement claims.

Completion Year: 2021
Hazard Vulnerability: Floods
Mitigation Project Type: Culvert Upgrade, Phased
Funding Source: HMGP 4195

County: Washtenaw
Subrecipient: City of Ann Arbor
Location: City of Ann Arbor
Disadvantaged Community: No





Total Cost: $6,703,339.57 **Total Federal Share:** $4,962,477.87 **Non-federal Share:** $1,740,861
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $104,350

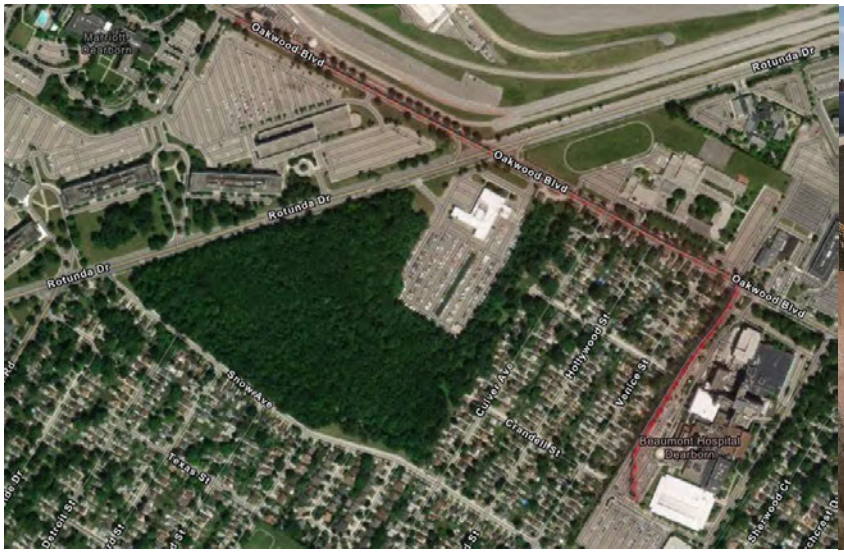
Scope of Work Summary: The City of Ann Arbor successfully completed a two-phased project consisting of the HMA application development, project design, and construction of a flood relief opening in a railroad berm spanning Allen Creek. This consisted of the construction of: two approximately 200 feet by 12 feet by 7 feet hydraulic box culverts within an existing railroad berm (culvert bottom at approximately 12 feet below grade) with an underground outlet to the Huron River; a new concrete apron and headwalls with riprap; a drainage swale in the berm; a hydraulic weir associated with the hydraulic culverts at approximately 7 feet deep, with bollards for protection; and 286 linear feet of 48-inch pipe storm sewer improvements at approximately 7 feet deep. Temporary roads, staging areas, erosion control measures, and steel sheet piling were used to prepare for construction. An agreement with MDOT and Amtrak limited the closure of the track section included in the project to 37 hours. The removal of tracks, excavation of soil, burying of the box culverts and pedestrian tunnels, not included in the HMA grant, and regrading and installation of tracks were successfully completed within the allotted time. The completion of the project reduced the first flood elevation by more than five feet. This has or ultimately will result in the removal of several buildings from the special flood hazard area floodplain.

A pedestrian tunnel under the train tracks but above the hydraulic box culverts and connecting pathways were installed concurrently as the HMA project but identified and paid entirely from non-FEMA funds since they are ineligible in accordance with FEA HMA grant policy.

The City of Ann Arbor Allen Creek watershed that includes the project area experienced between a two and five-year rainfall event June 25-26, 2021 (DR-4607) totaling three inches over a 48-hour period. There were no reports of flooding along Depot Street that most likely would have experienced street and basement flooding without the completion of this flood mitigation project.

Completion Year: 2019
Hazard: Vulnerability: Floods
Mitigation Project Type: Culvert Upgrade, Stormwater Improvement
Funding Source: HMGP 4195

County: Wayne
Subrecipient: City of Dearborn
Location: City of Dearborn Oakwood Beaumont Dearborn Hospital
Disadvantaged Community: Yes



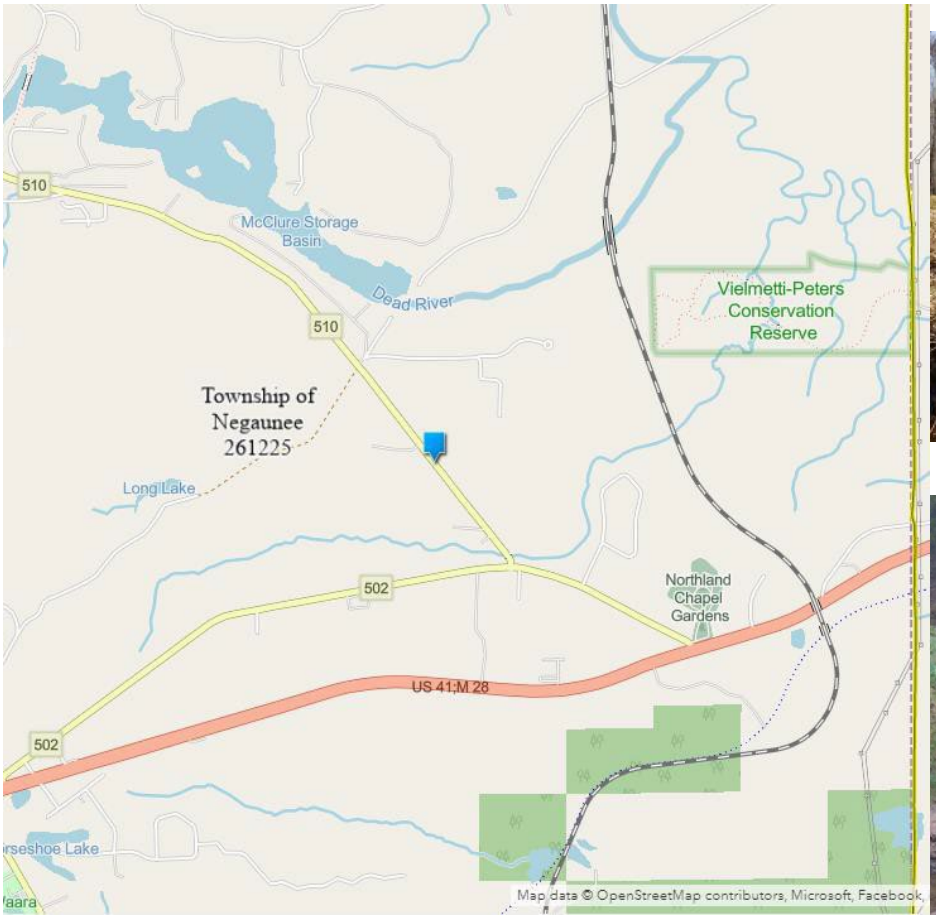
Total Cost: $7,164,564.98 **Total Federal Share:** $5,373,423.74 **Non-federal Share:** $1,791,141.
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $154,091

Scope of Work Summary: The Project consisted of the construction of a new storm sewer to collect storm water flow from the Beaumont/Oakwood Hospital property and convey it to an existing relief outfall to the Rouge River. This project successfully removed the hospital's storm water flow from the combined sewer system thereby reducing surcharging in the original combined sewer system. The storm sewers were installed below two neighboring streets. The project site is not located within a special floodplain hazard area. A scope of work modification was required to address the presence of an unknown abandoned arch culvert within the project site.

The City of Dearborn experienced heavy rainfall between the dates of June 25-26, 2021, totaling 7.48 inches over a 24-hour period. Based on the NOAA Atlas 14-point precipitation frequency estimates the 24-hour duration storm event constituted as a 1,000-year storm event. Widespread basement flooding was reported across the City of Dearborn including neighborhoods around the Beaumont-Oakwood Hospital property. However, the hospital did not experience any flooding thanks to the completed mitigation project. Without the project extensive flooding damage would have been expected.

Completion Year: 2013
Hazard Vulnerability: Floods
Mitigation Project Type: Culvert Upgrade
Funding Source: PDM 2009

County: Marquette
Subrecipient: Marquette County
Location: Negaunee Township
Disadvantaged Community: No



Pre-mitigation

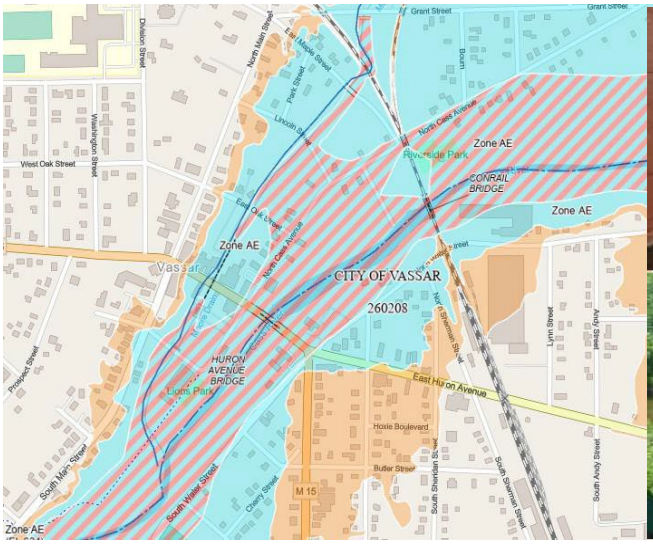
Post-mitigation

Total Cost: $101,959.53 **Total Federal Share:** $76,469.65 **Non-federal Share:** $25,489
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $51,372

Scope of Work Summary: Marquette County successfully completed a project to replace an existing 60-foot undersized culvert for an unnamed tributary on County Road 510. This included the removal of an existing three-foot diameter round corrugated metal culvert and the installation of a five-foot by three-foot diameter precast concrete arch culvert to pass the 100-year flood event and stabilizing adjacent stream bank and side slopes. The installation of the new culvert increased the water flow from 15-20 cubic-feet per second up to approximately 57 cubic-feet per second.

Completion Year: 2007
Hazard Vulnerability: Floods
Mitigation Project Type: Culvert Upgrade, Berm Improvement, Backflow Preventor installation, Flood Diversion, Conduit Installation.
Funding Source: HMGP 1346

County: Tuscola
Subrecipient: Tuscola County Drain Commissioner
Location: City of Vassar
Disadvantaged Community: No



Pre-mitigation

Post-mitigation

Total Cost: $2,910.252.68 **Total Federal Share:** $1,785,000.00 **Non-federal Share:** $1,125,252
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $187,259

Scope of Work Summary: The City of Vassar downtown is in the heart of the floodplain, with the Moore Drain and Cass River running parallel through town and converging just west of M-15. When the waters rise too high it is not possible to contain the flood. A three-part flood mitigation project constructed to mitigate flooding of the downtown by reducing the ability of Cass River water flow from backing up into the Moore Drain.

The project components included:
1. Modification of the Cass River Berm - The existing berm was extended 3,700 feet; sheet pile was installed in line with the berm to fill in gaps where space would not allow for the construction of a berm; and the existing berm was widened and built taller.
2. Hydraulic Improvements that increased the capacity of the Moore Drain - Five culverts were upsized to larger box culverts; A flap gate was installed at the drain outlet preventing backflow of the Cass River into the drain.
3. Installation of a 900-foot Floodwater Diversion Conduit Installation - A diversion conduit was constructed to head off some of the water from the Moore Drain and route it out to the Cass River instead of passing it through town.

On February 13, 2009, the Cass River crested at 17.27 feet, more than two feet above moderate flood stage. According to the Tuscola County Emergency Manager, in the past, a flood of this depth would have left several feet of water in downtown businesses and all traffic, including first responders, would have had to be rerouted around the downtown area. In this event, there were “some minor flood issues in a couple of stores” and only truck traffic was rerouted. According to a local news report during the event, floodwaters were 6-12 inches in as many as six stores, but all businesses were able to remain open. In a television interview, the City Manager for Vassar at the time indicated that he estimated floodwaters from this event would have been approximately three times deeper prior to the completion of the mitigation project.

Completed: 2008
Hazard Vulnerability: Floods
Mitigation Project Type: Culvert Upgrade, Detention/Retention Basin Installation
Funding Source: HMGP 1346

County: Bay
Subrecipient: Bay County Drain Commissioner
Location: Williams Township
Disadvantaged Community: No

Total Cost: $1,294,968.27 **Total Federal Share:** $971,226.18 **Non-federal Share:** $323,742.09
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $121,999

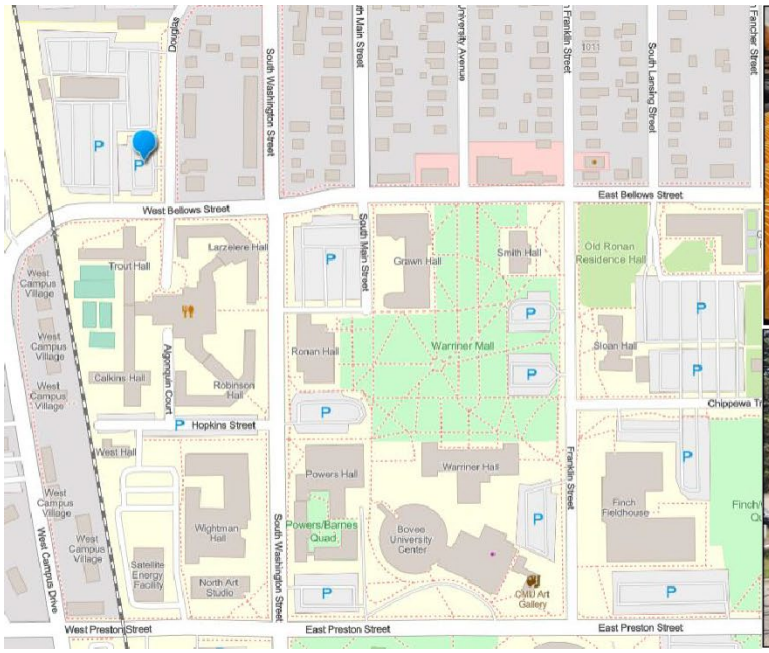
Scope of Work Summary: The mitigation project involved the construction of a large detention basin (approximately 23 acres); more than a mile of drain channel improvements; replacement/installation of 4 culverts, construction of low-level berms along portions of the drain system and placement of riprap to control erosion.

The previous capacity of the drainage system through this neighborhood could handle a 10% annual chance flood (previously known as a "10-year" storm event). The new system is designed to handle more than a 1% annual chance flood (a flood that has a 1% chance of occurring in any given year). Prior to the initiation of the project, the neighborhood was typically impacted by flood damages approximately every 10 years. The project application contains documentation of Major floods resulting in significant damage in this area in 1986 and 1996.

In June of 2017, another significant flooding event occurred in Bay and several neighboring counties resulting in disaster 4326-DR-MI. As depicted in the image above, the detention basis stored excess flood water and spared these homes from damage. The county drain commissioner stated it is difficult to assess the exact savings from this event, but impacts would likely have exceeded damages from presidential disaster 1128-DR-MI in 1996 which caused millions of dollars in damage. The project also provided benefits soon after completion from the annual "spring thaw" and a significant rain event in May 2009 which resulted in excess surface water runoff and caused a substantial increase in the volume of water entering the drain system. According to county staff, that event would normally have resulted in calls from neighborhood residents to complain of flooding, but the phones were silent this time around.

Completed: 2021
Hazard Vulnerability: Floods
Mitigation Project Type: Detention/ Retention Basin Installation, Culvert Upgrading
Funding Source: HMGP 4326

County: Isabella
Subrecipient: Central Michigan University (CMU)
Location: North Campus, Mt Pleasant City
Disadvantaged Community: No



Total Cost: $540,331 **Total Federal Share:** $405,248.25 **Non-federal Share:** $135,082.75
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $10,032.75

Scope of Work Summary: On June 22 and 23, 2017, (DR-4326) six inches of rain fell on campus overnight resulting in a one-day closure of campus and millions of dollars of damage to campus buildings. This underground detention basin was installed to protect nine residence halls and one dining hall damaged during the DR-4326 flooding disaster. In addition, City of Mt. Pleasant properties located north of West Bellow Street and east of South Washington Street are also better protected from flooding because of this mitigation project. The protection is based on the reduction of the water flow within the watershed, by the construction of the underground storage basin, thus reducing the confluence of stormwater at the stormwater structure (manhole) located at West Bellow Street and South Washington Street. The underground stormwater basin is designed to support a 50-year storm.

The project included the construction of an 18,913 cubic feet underground stormwater detention basin beneath CMU's Parking Lot Two that was connected to an existing stormwater line. The basin is 60-feet by 150-feet and two-feet deep. New manhole structures were installed at the southeast corner, connecting the basin to the existing stormwater line via 79 linear feet of new 18-inch stormwater pipe. At the west side of the basin, a new manhole connects with 34 linear feet of 12-inch stormwater pipe west to the Upton Drain. Following construction, the site was regraded and reseeded, the parking lot repaved, and the light pole, sidewalk, curbing, and ramps were replaced.

Within a month of completion, the project area experienced a five-year storm event, and no flooding was observed upstream of the project.

Completed: 2019
Hazard Vulnerability: Floods
Mitigation Project Type: Detention/ Retention Basin Improvement, Culvert Upgrading
Funding Source: PDM 2019

County: Isabella
Subrecipient: Central Michigan University (CMU)
Location: South Campus, Mt. Pleasant City
Disadvantaged Community: No

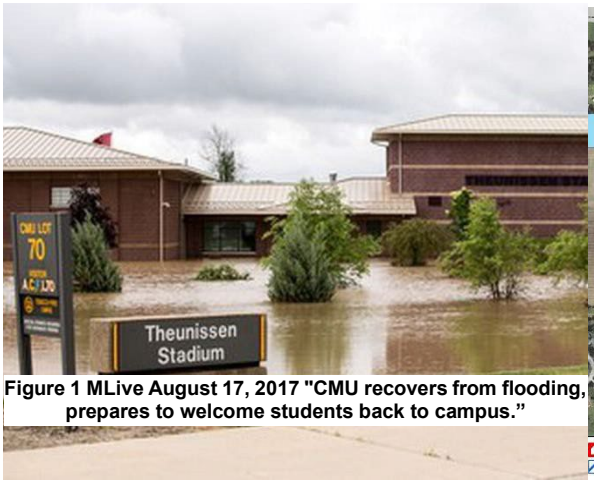
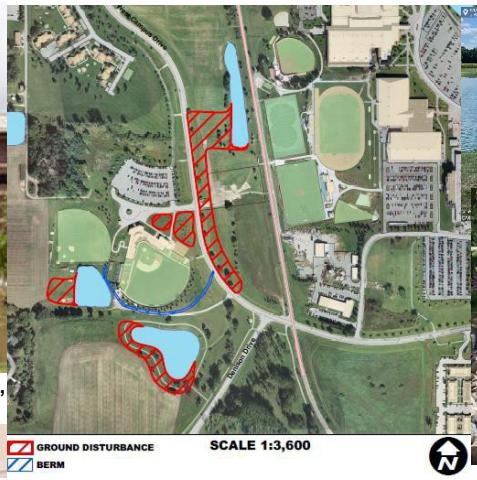


Figure 1 MLive August 17, 2017 "CMU recovers from flooding, prepares to welcome students back to campus."



Total Cost: $907,884.38 **Federal Share:** $680,913.38 **Non-federal Share:** $226,971
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $23,089

Scope of Work Summary: On June 22 and 23, 2017 (DR 4326), six inches of rain fell on campus overnight resulting in a one-day closure of campus and millions of dollars of damages to south campus buildings. CMU completed the following project within its south campus to mitigate damages from similar future flooding events on site and for the downstream communities of the City of Mt. Pleasant and Union Township.

This project included the expansion of two Theunissen Baseball Stadium detention ponds with the inclusion of rip rap at outfall and 8,000-sf of a replacement asphalt path. The expansion of the West Detention Pond with a reinforced vegetative spillway at the north end consisting of 400 cubic yards of soil and 450 square yards of soil reinforcement blanket, along with the adjustment of castings at the control structure. The creation of two new detention ponds with a combined storage capacity of 0.8 acre-feet on the north side of Theunissen Stadium and connected by 32-linear feet of 15-inch storm sewer with 15-linear feet of sidewalk repair. The installation of a 1,080-linear foot berm approximately 3-feet high on the south side of Theunissen Stadium. The creation of approximately 1,060-linear feet of open ditch for stormwater flow excavated to a depth of 3.5-feet with 50-linear feet of 36-inch storm sewer under the existing drive on the east side of West Campus Drive. The installation of approximately 4,800-square yards of erosion blanket and 80 cubic yards of rip rap at the outfalls. The installation of 810-linear feet of 30-inch storm sewer, and the installation of a 30-inch culvert under West Campus Drive. The removal of Portions of the existing storm sewer system. The abandoning in place of some sections of existing storm sewer.

After project approval, modifications were made to the scope of work due to newly available topographic survey information, as well as engineering feasibility and adjustments to account for elevation conflicts with two existing pipes encountered during construction. FEMA denied a retroactive scope of work and budget modification request for the added items that were implemented without prior FEMA approval. As a result, costs associated with the completed work that was not part of the originally approved scope of work were ineligible and not attributed to this grant as either Federal share costs or non-Federal matching costs.

Completed: 2018
Hazard Vulnerability: Floods
Mitigation Project Type: Retention/ Detention Basin Installation, Culvert Upgrading
Funding Source: HMGP 4195

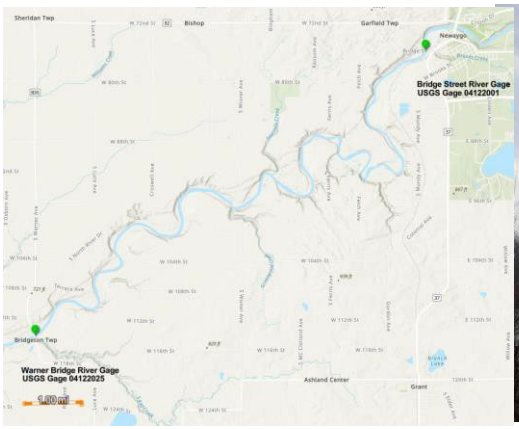
County: Clinton
Subrecipient: Clinton County Drain Commission
Location: Fowler Village, Dallas Township, Waltz & Sturgis Drain
Disadvantaged Community: No

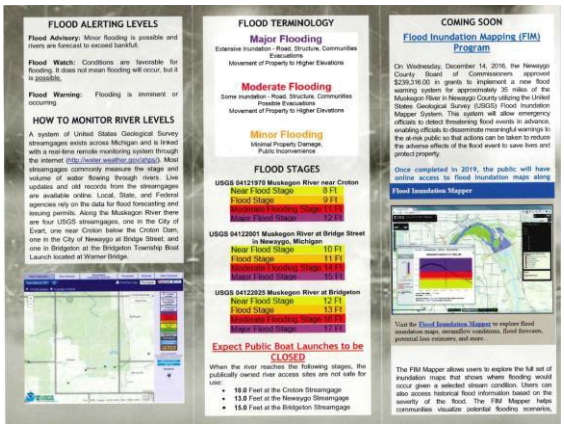
Total Cost: $784,855 **Total Federal Share:** $588,641 **Non-federal Share:** $196,214
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $18,271

Scope of Work Summary: The project resulted in the replacement of two undersized culverts at Sixth Street and Maple Street and Fifth Street and Maple Street. Thirty-six-inch by 60-inch corrugated metal pipes were upgraded to 60-inch round reinforced concrete pipe with a modified design of underdrain headwalls and bar grates. A 41.2 acre-feet of storage regional detention basin was constructed on 13.03 acres of acquired land. Spoils from the excavation of approximately 33,000 cubic yards of soil were used to construct a berm along the north and east sides of the property with a top width of 12 feet with 1:6 side slopes. The detention basin 24-inch outlet was constructed with the spillway at an elevation of 751.7 feet. Existing 12-inch and 18-inch county drain underdrain clay tiles were upgraded with a single 18-inch pipe downstream of the detention basin in place of the channel lowering and widening of a county open ditch above those tiles. Four concrete catch basins/manholes were installed along the new pipe.

Completion Year: 2021
Hazard Vulnerability: Floods
Mitigation Project Type: 5% Initiative, Flood Warning System
Funding Source: HMGP 4195

County: Newaygo
Subrecipient: Newaygo County
Location: Muskegon River, Newaygo City, Grant City, Bridgeton Township.
Disadvantaged Community: Yes





Total Cost: $168,934.30 **Federal Share:** $126,934.30 **Non-federal Share:** $42,000.00
Cost Effectiveness Methodology: BCA Narrative **Expected Annual Benefit**: Not calculated.

Scope of Work Summary: Flood inundation maps were created for the Muskegon River in Newaygo County, Michigan. The extent of the model is approximately 32 river miles of the Muskegon River from Croton Drive to Maple Island Road. Field work was completed by USACE, by a separate agreement with Newaygo County, and served to the United States Geological Survey (USGS). Two additional USGS operated stream gages were installed on the Muskegon River at Newaygo and Bridgeton.

Flood inundation maps, in conjunction with NWS flood forecasts and USGS real-time data, at the three stream gages on the Muskegon River allows the flood inundation map library to be used as a flood warning tool. The model and maps have been reviewed and are functional. The flood inundation maps are uploaded to the USGS review mapper and are functional and publicly available.

To announce the project and provide a high-level overview, Newaygo County Emergency Services hosted a community meeting on March 15, 2018. Representatives from the NWS Grand Rapids Office, USGS, and Department of Natural Resources (DNR) were subject matter expert speakers during this meeting. In addition, flood warning systems brochures were developed, printed, and distributed during the meeting.

A follow-up community meeting was scheduled to take place on March 26, 2020. The purpose of this meeting was to educate community members on the use of the USGS Flood Inundation Mapper system. This meeting was cancelled due to the COVID-19 pandemic.

Year Completed: 2019
Hazard Vulnerability: Floods
Mitigation Project Type: Utility Protection
Funding Source: HMGP 4195

County: Macomb
Subrecipient: Clinton Township
Location: Little Miller Drain
Disadvantaged Community: No



Total Cost: $210,264.46 **Total Federal Share:** $157,698.35 **Non-federal Share:** $52,566
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $12,963

Scope of Work Summary: The project included the replacement of eight existing sanitary sewer manhole frames and covers for the Little Millar Pump Station District with new watertight frames and covers of equivalent size. The work included all necessary earth excavation to properly expose the covers; the demolition of the existing concrete collar wrapped around the frame connecting it to the top of the concrete structure; and the removal of the entire casting from the site. New frames were set in place and adjusted in a bed of mortar to the designed grade, such that the ground surrounding the new rim has positive drainage and is easily maintained. The frames and covers meet necessary structural requirements and include the wording SANITARY SEWER, a rubber gasket, and tightening bolts.

The two existing flat concrete manhole tops on the pump station wet well and valve vault were removed and replaced by a new concrete flat top for the wet well and valve vault. The structures were installed with a watertight seal between the top and the structure walls. Installed access hatches and manhole frame/covers are also watertight and oriented to ensure optimal ease of entry into the structures.

The existing electrical cabinets and internal components were disconnected and removed. A new electrical cabinet transformer and control panel for the pump station were installed at a remote location along Utica Road at Millar Road, outside of the 0.5% flood level. A new power disconnect switch was installed 2 feet above the 0.5% flood level of the Clinton River Floodplain at the site where the existing electrical cabinets were removed.

Conduits measuring 758 linear feet and of 1.5-inch diameter were installed using directional drilling along the south side of Millar Road, connecting the new electrical cabinet transformer and control panel location to the new power disconnect switch.

The final design for the project included the addition of a few items installed without preapproval from FEMA. Those items included the addition of security lighting, a thicker concrete pad for the control panel, and a concrete pad for the transformer. FEMA denied a retroactive scope of work modification request. As a result, the expenses of the additional and modified items were ineligible. This resulted in a delay in reimbursement and a deobligation of $15,575.65 of the federal funds initially approved for the project.

On January 11, 2020, flooding from a severe storm event covered the pump station wet well, valve vault, and several manholes. There was no disruption to sanitary sewer service to any customers from the event. These improvements helped to avert the likelihood of a pump station electrical cabinet transformer or control panel power loss without the completion of this project.

Years Completed: 2015, 2022, 2023
Hazard Vulnerability: Floods
Mitigation Project Type: Structure Elevation
Funding Source: RFC 2012 (2 properties), HMGP 4195 (12 properties), PDM 2016 (0 properties), PDM 2017 (3 properties), PDM 2019 (0 properties)

County: Monroe
Subrecipient: Village of Estral Beach
Location: Village of Estral Beach, Newport
Disadvantaged Community: No

Pre-mitigation

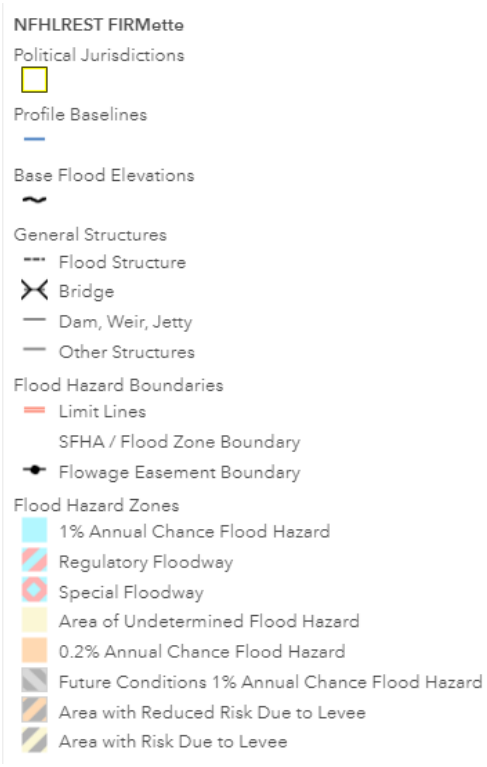
Post-mitigation

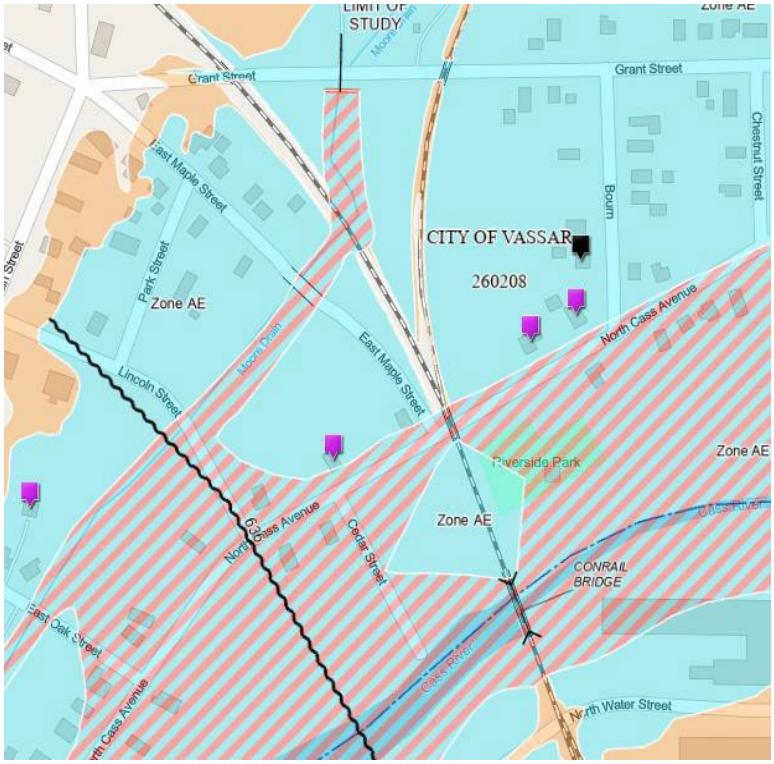
Total Cost: $1,655,671.26 **Total Federal Share:** $1,289,806.45 **Non-federal Share:** $365,864.81
Cost Effectiveness Method: FEMA BCA / Precalculated Benefits **Estimated Annual Benefit:** $116,166.67

Scope of Work Summary: Seventeen homes residing in the Village of Estral Beach have been elevated by HMA grants. All structures were elevated at least two feet above the base flood elevation in compliance with both the NFIP and local floodplain ordinances. The structures were elevated on eight-inch concrete block or on piles with appropriately sized flood vents. Utilities disconnected to lift the buildings were reconnected above the base flood elevation on the elevated homes. Final carpentry work was then completed to restore the structures. The 17 property deeds are restricted to require flood insurance for the life of the property. Some of the homes were relocated as they were elevated on their parcels to meet local ordinance setback requirements. Many of the homeowners completed grant ineligible elective improvements concurrently with the eligible activities required to elevate the homes.

Completion Years: 2000, 2021
Hazard Vulnerability: Floods
Mitigation Project Type: Structure Elevation
Funding Source: FMA1998 (4 properties), FMA 2000 (1 property)

County: Tuscola
Subrecipient: City of Vassar
Location: City of Vassar
Disadvantaged Community: No





Total Cost: $275,873.00 **Total Federal Share:** $206,905.00 **Non-federal Share:** $68,968.00
Cost Effectiveness Method: FEMA BCA / Precalculated Benefits **Estimated Annual Benefit:** $8,750.00

Scope of Work Summary: Five homes residing in the City of Vassar have been elevated by HMA grants. All structures were elevated in compliance with both the NFIP and local floodplain ordinances. The five property deeds are restricted to require flood insurance for the life of the property.

Year Completed: 2019
Hazard Vulnerability: Geological, Erosion Subsidence
Mitigation Project Type: Stream Bank Stabilization
Funding Source: HMGP 4195

County: Allegan
Subrecipient: City of Allegan
Location: City of Allegan, Perrigo Headquarters
Disadvantaged Community: Yes

Pre-mitigation

Post-mitigation

Total Cost: $4,457,888.83 **Federal Share:** $3,343,416.62 **Non-federal Share:** $1,114,472.21
Cost Effectiveness Methodology: FEMA BCA Module **Expected Annual Benefit:** $247,409.53

Scope of Work Summary: The project stabilized the eroding eastern bank of the Kalamazoo River below the North American Headquarters of the Perrigo Company. Soil and retaining structures were added to the east bank while cutting back soil on the west bank to allow for proper river flow. FEMA approved a post-award scope of work modification request that added the repair of interior cracking in the Perrigo building resulting from the installation of the retaining structures. Other added items included repairs to the landscaping consisting of the replacement of an existing underground sprinkler system, asphalt paving, curb, and gutter repair/paving, landscape seeding, and the replacement of a chain-link fence with a wrought iron fence funded entirely by local private funds. The project site is located within a special floodplain hazard area.

Completion Year: 2013
Hazard Vulnerability: Geological, Erosion, subsidence, High Wind
Mitigation Project Type: Dune Stabilization/Restoration
Funding Source: PDM 2009

County: Marquette
Subrecipient: Marquette County
Location: Chocolay Township
Disadvantaged Community: No

Pre- Mitigation Project

Post- Mitigation Project

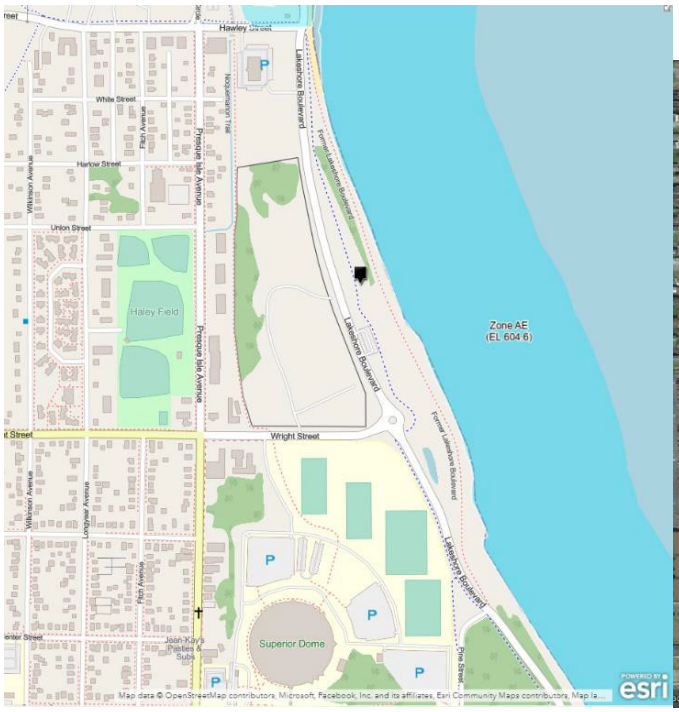
Total Cost: $133,904.60 **Total Federal Share:** $98,969.45 **Non-federal Share:** $34,935
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $86,151

Scope of Work Summary:
Marquette County completed a successful hazard mitigation project at two sections of State Highway M-28 along the Lake Superior coastline. The planting of native species of vegetation (grass, shrubs, and trees) now controls severe erosion and provides wind breaks protecting motorists from blowing sand and snow.

Prioritized erosion sites, including deep gullies and large blow-outs, were stabilized using a clean sand fill and native plant species consisting of but not limited to beach grass, beach pea, sandy cherry, and common juniper. Clean sand fill used for the project was sourced locally from a MDOT sand storage site, a MDOT sand excavation pit, and township sand excavation pit. Sand was screened for invasive plants and hazardous debris prior to being placed on project location. Planted native shrubs and trees adjacent to scenic turnouts and state highway M-28 provide wind breaks. Species such as red pine, white pine, and jack pine will be used for the wind breaks. The installation of small public education signs and distribution of informational brochures were included in the project.

Completion Year: 2020
Hazard Vulnerability: Geological, Erosion, Subsidence
Mitigation Project Type: Utility Relocation
Funding Source: PDM 2018

County: Marquette
Subrecipient: City of Marquette
Location: City of Marquette
Disadvantaged Community: No



Pre-mitigation

Post-mitigation

Total Cost: $1,890,928.51 **Total Federal Share:** $1,418,196.38 **Non-federal Share:** $472,732
Cost Effectiveness Method: FEMA BCA Module **Expected Annual Benefit:** $671,195

Scope of Work Summary: The project consisted of relocating a 4,200-foot section of Lakeshore Boulevard and the underlying water, sewer, and storm sewer utilities (400 feet inland from the Lake Superior coastline onto city-owned vacant property). The project required a full environmental assessment.

Completed: 2018
Hazard Vulnerability: Weather, Tornadoes, High Winds,
Mitigation Project Type: Weather, 5% Initiative, Warning Siren Installation.
Funding Source: HMGP 4195

County: Genesee
Subrecipient: Genesee County
Location: Atlas Twp., Burton City, Clayton Twp., Davison Twp., Flushing Twp., Gaines Twp., Mundy Twp., Richfield Twp.
Disadvantaged Community: No

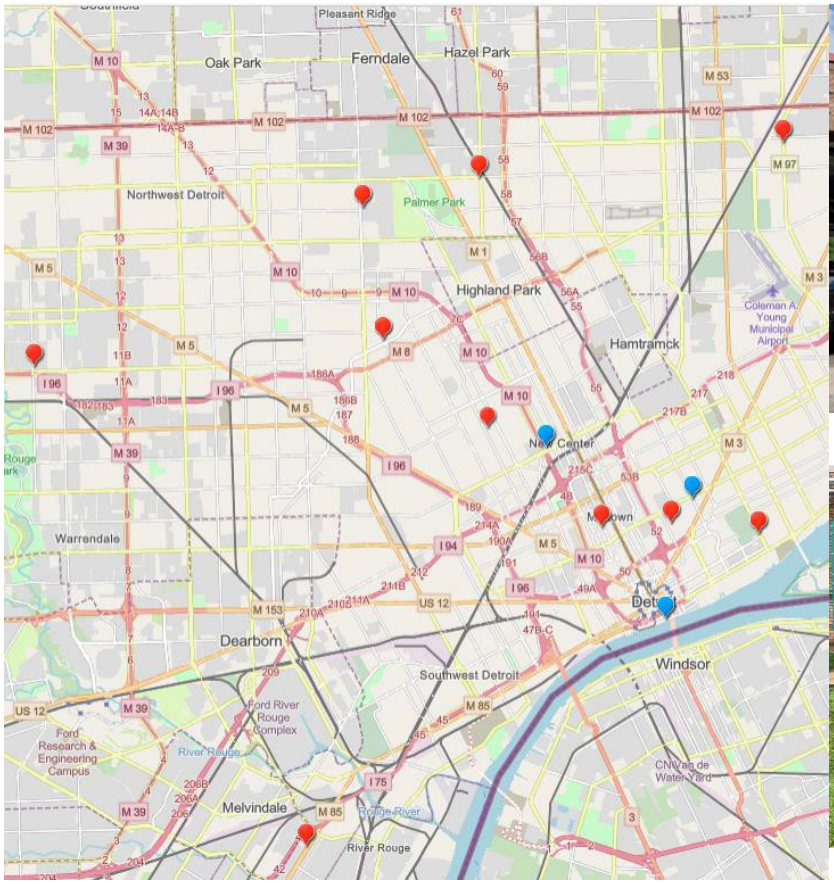
Total Cost: $469,517.75 **Federal Share:** $347,497.79 **Non-federal Share:** $122,019.96
Cost Effectiveness Methodology: BCA Narrative **Expected Annual Benefit:** Not Applicable

Scope of Work Summary: According to the FEMA NRI, Genesee County has a high risk of tornadoes and very high risk of high wind events. Thirty-eight tornadoes touched down in the county between 1950-2021 for an annualized frequency of 0.3 events per year. From 1986 to 2021, the county experienced 201 strong wind events for an annualized frequency of 5.9 events per year.

This project included the installation of 24 warning sirens in various locations throughout the county. The sirens are Federal Signal 2001-130 with two-way technology mounted on 50-inch wooden poles. Holes measuring approximately 24 inches in diameter and 8 feet deep were dug for each siren pole. The total ground disturbance for each pole was approximately 0.59 cubic yards of previously disturbed soil. Five sirens required trenching through previously disturbed ground in the utility right-of-way to connect the sirens to power. All trenches were 2 feet deep and varied in length. All other sirens either have overhead power connections or used existing trenching for electrical conduit. The siren locations are in heavier population areas outside the City of Flint, which is the urban center of the county. The sirens fill gaps in the pre-existing warnings system of 98 sirens. These sirens increased the warning capacity for approximately 37,759 additional residents. All sirens in the system can be activated county-wide from Genesee County Central Dispatch.

Year Completed: 2020
Hazard Vulnerability: Weather, Power outage
Mitigation Project Type: 5% Initiative
Funding Source: Legislative Pre-Disaster Mitigation 2008, HMGP 4195

County: Wayne
Subrecipient: City of Detroit
Location: City of Detroit
Disadvantaged Community: Yes



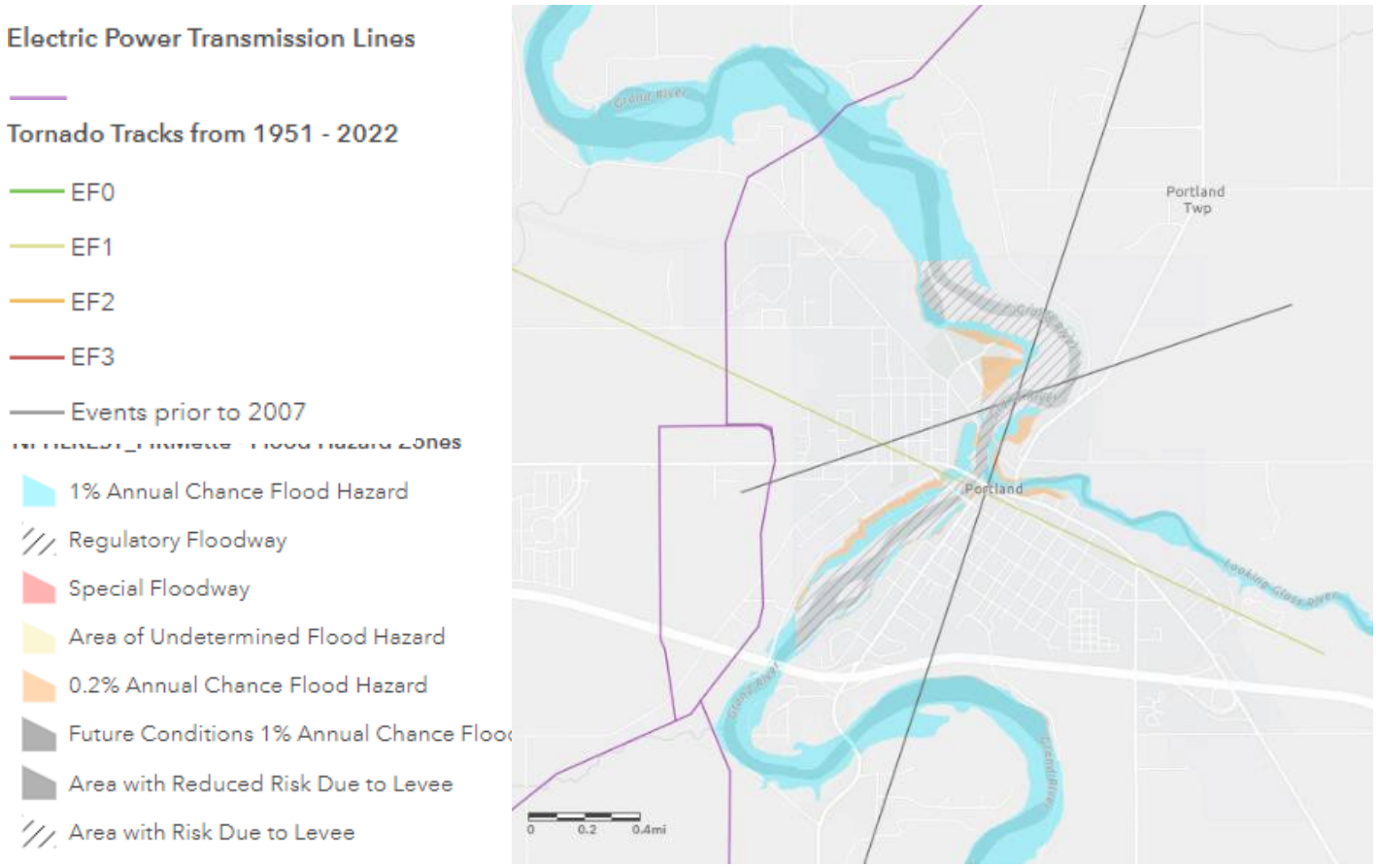
Total Cost: $1,715,863.46 **Federal Share:** $749,447.60 **Non-federal Share:** $966,420.86
Cost Effectiveness Methodology: BCA Narrative **Expected Annual Benefit**: Not Applicable

Scope of Work Summary: Backup power generators and automatic transfer switches were installed at ten City of Detroit Fire Stations and three Police Precincts. The generators, automatic transfer switches, and equipment were designed (site specific) and described in the grant agreements to provide power to the entire building (including the garage and garage doors if present) to enable continued communications, safety, and security operations at the fire stations and police precincts. The generators are powered by natural gas.

To complete the project, the subrecipient did incur additional expenses after the period of performance deadline. Those costs were ineligible for reimbursement.

Completion Date: 2006
Hazard Vulnerability: Weather, Tornadoes, High Winds; Floods, Ice Jams
Mitigation Project Type: Powerline Burial
Funding Source: HMGP 1346

County: Ionia
Subrecipient: City of Portland
Location: City of Portland, Portland Township
Disadvantaged Community: No



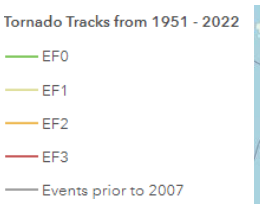
Total Cost: $276,827.08 **Federal Share:** $207,620.31 **Non-federal Share:** $69,206.77
Cost Effectiveness Methodology: BCA Module **Expected Annual Benefit**: $100,829.00

Scope of Work Summary: This successful project rerouted overhead electrical power lines to an underground system including two river crossings to mitigate the loss of power to residents resulting from severe windstorm and ice jam events that frequently knocked down power poles. The project included the directional drilling of ten conduits approximately 600 feet under the Grand River, ten conduits approximately 200 feet under the Looking Glass River, and the installation of nine wires in existing underground conduit and the two river crossings for a length of approximately 3,300 feet (connected to existing underground wires at each end of the project). Finally, overhead wires and poles were removed. The project site is located at the confluence of the Looking Glass and Grand Rivers.

In February 2019, the city experienced significant ice jamming through town. Without the completed project, most of the poles that were removed as part of this project would have been taken down by the ice and many people in the city would have lost power. The city public works manager at the time said this FEMA grant catalyzed, and to some extent enabled, the city to bury most of its power lines. Eighty-five percent of the City of Portland's powerlines are buried as of 2019. Prior to this project and the additional burials, the followed, the electric department would receive at least one call per workday for a power outage. As of 2019, they receive no more than three per year at the Portland Electric Department.

Completion Date: 2021
Hazard Vulnerability: Weather, Tornadoes, High Winds
Mitigation Project Type: Community Saferoom**,** Phased
Funding Source: HMGP 4195, PDM 2017

County: Grand Traverse, Roscommon, St. Clair, Wayne
Subrecipient: DNR
Location: Interlochen SP, Maybury SP, Lakeport SP, South Higgin Lake SP, Green Lake Township, Gerrish Township, Northville Township, Burtchville Township, Traverse City SP, East Bay Township
Disadvantaged Community: No



Total Cost: $4,660,948.12 **Federal Share:** $3,495,711.09 **Non-federal Share:** $1,165,237
Cost Effectiveness Methodology: BCA Module **Expected Annual Benefit**: $342,532

Scope of Work Summary: The Michigan Department of Natural Resources (MDNR) completed two HMA grant projects to construct six dual-use buildings in five state park campgrounds functioning as both public safe rooms and either park headquarters or toilet/ shower buildings. A phased HMGP grant funded the design of eight safe rooms and then the construction of five of the facilities.

The constructed toilet/shower dual-use safe rooms are approximately 47 feet by 66 feet each and the headquarters dual-use safe rooms are approximately 163 feet by 61 feet each. Existing structures were removed to make room for the construction of the new code complaint safe rooms. Up to one acre of new ground disturbance occurred for each structure, with structural footers extending up to four feet below grade. Additional disturbance to a depth of approximately four feet occurred for new utilities, removal of existing utilities, and for installing connections to the safe rooms. Ground disturbance to a depth of approximately 14 inches for adjacent parking lots/driveways, and eight inches for adjacent pathways also occurred as part of the project. The safe rooms were constructed and certified in compliance with the International Code Council and FEMA P361 Guidance for Community and Residential Safe Rooms.

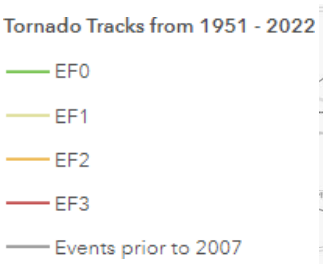
Grant ineligible construction related items associated with the headquarters and toilet/shower components of the buildings were completed concurrently as project eligible costs. However, those costs were identified and paid for entirely by MDNR.

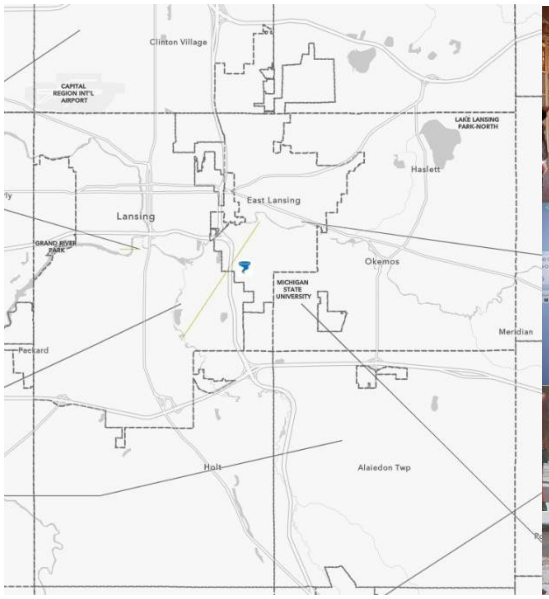
Building Specifications:

Saferoom Building	Building Footprint (Ft^2)	Usable Footprint (Ft^2)	Maximum Occupancy (persons)
Interlochen SP Headquarters	9,943	1,522	302
Maybury SP Headquarters	9,943	1,522	302
Lakeport SP Toilet/ Shower	3,102	1,610	321
South Higgins Lake SP Toilet/ Shower	3,102	1,610	321
Interlochen SP Toilet/ Shower	3,102	1,610	321
Traverse City SP Toilet/ Shower	3,102	1,610	321

Completion Year: 2003
Hazard Vulnerability: Weather, Tornadoes, High Winds
Mitigation Project Type: Community Saferoom
Funding Source: HMGP 1346

County: Ingham
Subrecipient: Michigan State University (MSU)
Location: Spartan Child Development Center, Spartan Village, MSU, East Lansing City
Disadvantaged Community: No





Total Cost: $165,000.00 **Federal Share:** $123,750 **Non-federal:** $41,250
Cost Effectiveness Methodology: BCA Module **Estimated Annual Benefit:** $13,207

Scope of Work Summary: The greater East Lansing area experienced four tornadoes between 1950 and 2022 and has a high-risk rating for tornado hazards according to the FEMA's NRI since the area is included in Zone IV of FEMA's Wind Zones of the United States Prediction Map.

In efforts to mitigate damage and injury from such events, MSU successfully completed an HMA project to include FEMA P361 compliant components in the construction of a new childcare facility to serve as saferooms during severe weather events that could withstand winds up to 250 mph.

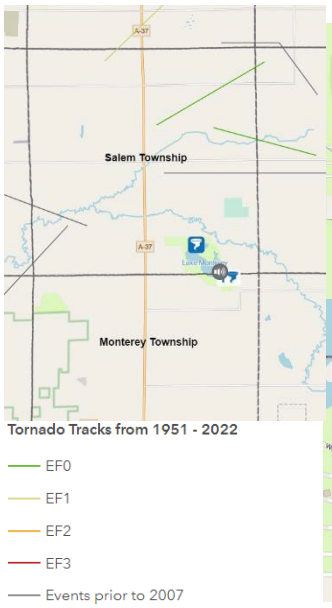
The facility is a one-story wood frame structure of residential character built on a concrete slab. MSU opted to construct the storm rooms as vestibules between the main corridor and each classroom, thereby always assuring proximity to the shelters. The storm room space contains student lockers with a bench in front of each locker for the child to sit and remove boots or shoes. Each of the eight storm rooms provides enough space to accommodate 20-25 children and adults and is equipped with an emergency kit, emergency lighting, and ventilation in case of a power failure.

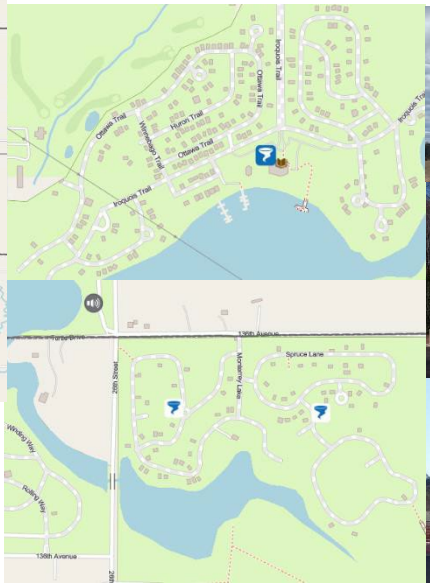
Only costs associated with hardening the building against tornadoes in compliance with FEMA P361, 7.5% of total construction, were included as grant eligible expenses. Finishes, non-shelter use components, and non-hardened construction were completed concurrently as project eligible costs but were identified and paid for entirely by MSU.

A tornado touched down within .33 miles of the facility in September 2007. The event occurred in the evening outside of business hours, but the occurrence reinforced the importance of such facilities to public safety in the area.

Completion Years:2019, 2021
Hazard Vulnerability: Weather, Tornadoes, High Winds
Mitigation Project Type: Community Saferoom, Phased
Funding Source: HMGP 4195; PDMC-PJ-05-MI-2017

County: Allegan
Subrecipient: Salem Township
Location: Sandy Pines Campground, Salem Township, Monterey Township
Disadvantaged Community: No





Total Cost: $3,835,653.42 **Federal Share:** $2,864,240.07 **Non-federal Share:** $971,413.35
Cost Effectiveness Methodology: BCA Module **Expected Annual Benefit**: $201,699

Scope of Work Summary: Salem and Monterey Townships in Allegan County are home to Sandy Pines Campground. This popular summer recreation destination has over 2,500 campsites, hosting as many as 25,000 people on busy summer weekends. Fortunately, Sandy Pines Campground has not been struck by a tornado. However, Salem Township and Monterey Township did suffer a total of seven tornado events from 1950 to 2021. The area is included in Zone IV of FEMA's Wind Zones of the United States Prediction Map.

Sandy Pines Campground in partnership with Salem Township has successfully completed two projects constructing three dual-use buildings within the property functioning as both 24-hour accessible community activity centers and storm shelters along with the installation of a 130dBc severe weather warning siren on the property. The siren's sound output can reach four square miles, covering the service area of the saferoom buildings.

Each building is wheelchair accessible and connected to a 38,000-kilowatt backup generator. The buildings were designed to accommodate the population of campers and residents within a quarter mile walking distance, a five-minute walk, or a half mile driving distance from each building when the campground is at full capacity.

Building Specifications:

Community Saferoom	Building Footprint (Ft^2)	Usable Footprint (Ft^2)	Maximum Occupancy (persons)
1	2,400	1,311	261
2	2,400	1,054	210
3	11,766	5,554	1,104

Only costs associated with hardening the storm shelter against tornadoes in compliance with FEMA P361 and International Code Council ICC-500 were included in the HMA grant. Finishes, non-shelter use components, and non-hardened construction were completed concurrently as project eligible costs. However, those costs were identified and paid for entirely by Sandy Pines.

End of Section 2

Section 3: Program Commentary

Michigan has utilized multiple sources of pre-disaster funding including BRIC, FMA, and PDM. Historically, the PDM program has been the main source of pre-disaster hazard mitigation funding in Michigan. Between 2002 and 2019, PDM resulted in the implementation of 92 hazard mitigation projects for nearly $24 million. With the creation of the BRIC program in 2020, PDM will no longer be available as an annually funded, nationally competitive program (though it has been used since 2020 as a program for congressionally directed spending on projects). In the initial three years of the BRIC program (2020-2022), Michigan has had 16 projects selected for funding which is anticipated to result in approximately $32 million invested in hazard mitigation (none of the selected projects are yet complete). The FMA program has been utilized in Michigan to a much lesser extent than BRIC and PDM, but it has still been a productive source of pre-disaster funding. Thirty-three FEMA projects have been implemented in Michigan for approximately $1.6 million.

The main source of post-disaster hazard mitigation funding is HMGP. Funding for HMGP in Michigan saw significant increases in 2020 and 2021 due to disaster declarations from three large disasters: 4494, 4547, and 4607. Prior to 2020, Michigan had 13 presidential disaster declarations between 1994 (the first declaration to make HMGP available in Michigan) and disaster 4381 in 2018 that, collectively, resulted in $81.4 million in HMGP funds for Michigan. Michigan's three most recent disasters from 2020 and 2021 have resulted in $88.5 million in available HMGP funds for Michigan which will allow for significant progress in mitigating disaster as that funding is utilized.

The HHPD Grant Program is still relatively new at the time of this writing and was not originally part of the previous 2019 MHMP. It provides funds for activities that reduce risks for eligible high hazard potential dams. The MHMP was revised to comply with the additional analysis that is required to receive these funds. Also newer, the STRLF provides funding for states and tribes to establish a revolving loan fund for issuing long-term, low interest loans to communities and tribes for implementing hazard mitigation measures to reduce risk from natural hazards. Fiscal year 2023 was the first year of the grant program and $50 million was made available nationally. Michigan submitted a grant application which was selected for funding. An additional $450 million is expected to be made available for fiscal years 2024-2027. The program is in its infancy, so no loans have yet been issued.

FEMA is currently informing states of the initial designations for CDRZ, a federal initiative that identifies select at-risk communities that are to receive special emphasis for hazard mitigation opportunities. One of the main goals of the initiative is to engage private sector partnerships and funding to assist in resiliency projects. Michigan will be involved in promoting the opportunities represented by CDRZ to help drive investment in resiliency for these areas. Some initial uncertainty over how FEMA selected designated census tracts came about because of differing at-risk community criteria that was being used. This matter was later resolved with FEMA.

Despite significant success implementing hazard mitigation measures in Michigan, there are also challenges associated with implementing these funding programs. Below are some of the more significant challenges along with strategies Michigan is implementing to address them:

Local Hazard Mitigation Plans

The majority of Michigan's population is covered by a local hazard mitigation plan. However, the level of coverage fluctuates over time as plans expire and others get approved. Ideally, the whole state would be covered by a local plan and there would not be lapses in coverage (between when a plan expires and when it is updated). There are several factors that contribute to plans expiring, including 1) communities not applying for planning grants early enough to start their planning process prior to their plan expiring, 2) lack of local matching funds for planning grants, 3) complexity of the planning requirements, 4) complexity of the grant application and implementation process, and 4) in some cases, lack of motivation or political will at the local level to complete a plan. Another challenge is that some local plans once written do not result in the eventual implementation of many of their proposed hazard mitigation actions.

Michigan has been working on several fronts to address local hazard mitigation planning challenges and will continue to seek ways to address them. One approach the state has taken is to request a FEMA FIT position for hazard mitigation. The intent for this position is to have a liaison who can spend more time with communities promoting hazard mitigation and hazard mitigation planning. The position would review Michigan's local hazard mitigation plan expiration dates and proactively contact communities in order to start the grant process early enough to avoid lapses. Another approach is partnering with FEMA to deliver "Plan to Action" workshops, where FEMA staff work with local planners and project managers during the plan update process to help identify mitigation actions that can be implemented with HMA funds. This will help to promote the development of grant applications.

Matching Funds for HMA Grants
One obstacle for communities to apply for HMA grants when implementing hazard mitigation actions from their local hazard mitigation plans is the availability of local match funding. Having enough local support to spend local dollars for implementing hazard mitigation projects has been a long-time struggle for communities. Recent changes in some of the HMA programs that have allowed increased federal cost share (90% for certain HMGP funding, and for disadvantaged communities in BRIC) has helped. Michigan continues to work with communities to identify potential sources of match. One strategy for this that is on the horizon is the potential use of STRLF dollars as a source for local match. The program allows for the issuance of low interest loans to communities to use as match for HMA grants. Michigan's revolving loan fund is not yet established but as the program is implemented and potentially grows, one of the goals will be to use the fund as a source of match for communities.

Complexity of Applying for HMA Grants
Applying for HMA grants is challenging. The programs are complex and application requirements are difficult. Many communities do not have local capacity to navigate these programs. Michigan continues to provide technical assistance to communities in applying for these grants. Another approach Michigan intends to use to address this challenge is to have the FEMA mitigation FIT position assist communities with identifying application development resources. Michigan has also, in limited capacity, used state level contracts to provide local assistance with application development, particularly in assisting with the development of benefit-cost analysis. This is an approach that the state will continue to take where possible. FEMA has also begun to allow communities to apply for project scoping grants that will grant money to communities to develop their hazard mitigation actions into approvable HMA grants. Michigan is promoting the use of this type of HMA application whenever possible and appropriate.

State Staffing Capacity
Because of the complexity of HMA programs, state staffing capacity needs are important to deliver the best possible hazard mitigation resources to communities. The FEMA is generous with management cost grants that allows the state to hire staff to help implement HMA grants. Unfortunately, these staff can only primarily work on the implementation of approved grants so there is a gap in staffing ability to help communities seek new grants. An increasing number of active disaster response activities can also divert staff time during emergency situations. Additionally, because of the nature of HMA management costs, Michigan has traditionally only been able to hire staff on a limited term basis. With the complexity of the programs, the state needs to be able to develop and retain long-term staff with knowledge of the programs. Turnover at the state government level has been high. The MSP/EMHSD continues to seek the addition of permanent staff positions for hazard mitigation. The MSP/EMHSD leadership has identified the addition of permanent staff positions as a priority for the division and is seeking avenues to accomplish this goal.

Tool Deficiencies
The NRI tool represents an opportunity for states in better identifying risk, vulnerabilities, and estimated annual losses. While the NRI holds promise, it could not be as robustly included in the plan as originally desired due to perceived deficiencies, gaps in data, and differences of opinion on how mapping is keyed and displayed. Some of these challenges included Michigan coastal risks being significantly underrepresented. This issue has yet to be resolved and finding the core gap in data has been elusive. Because the NRI multiplies some factors by zero, this results in an entire rating for a specific hazard/area to also be shown as zero (even if the zero is due to data gaps). Drought data also currently suffers from this problem. One potential reason is that NRI drought data tends to favor row crops, such as corn, whereas Michigan has many specialty crops, such as cherries. The estimated annual loss feature showed some artificially low figures due to these challenges. Counties that have these hazards will not feel comfortable robustly using the NRI until some of these problems can be addressed. While these challenges should be noted, the overall functionality of the tool holds great promise in assisting both state and local plans.

Alternative State Administrative Agencies
While MSP/EMHSD is the primary SAA for most FEMA grant programs, the HHPD Grant Program is run by EGLE. While this makes sense from a programmatic standpoint due to the technical expertise required to adequately assess dam risk, it does introduce an extra layer of complexity in coordination. This is especially true as EGLE adds or removes certain dams as being potentially HHPD grant eligible or makes other decisions that would necessitate changes to the MHMP (many of which are highly technical in nature). This is also important at the local level, as local hazard mitigation plans also need to be HHPD compliant in order for otherwise eligible dams to be able to ultimately receive funding. Most local governments do not have the technical expertise to become HHPD compliant on their own. To address these challenges, EGLE is responsible for providing technical information related to dam risk assessment (Appendix 8). The MHMP also includes an item in the Action Plan (Chapter 7) related to coordination between MSP/EMHSD and EGLE in regard to local hazard mitigation plans. See Appendix 8 for additional information (including challenges faced in administering the program and steps being taken to overcome funding and other obstacles).

Appendix 5: National Flood Insurance Program

The FEMA is responsible for mapping the countryôs flood risk through maps known as Flood Insurance Rate Maps (FIRM), one of the regulatory tools used by the NFIP. The NFIP makes flood insurance available in communities that have agreed to manage their floodplains in a manner geared towards minimizing future losses from flood damage. The NFIP is delivered directly by FEMA or through a network of companies that can write a policy under their own name (with FEMA still underwriting losses). The FEMA also provides information on how homeowners can understand flood zones and maps in order to help them decide if they desire to pursue obtaining flood insurance.

The State of Michigan also provides information on how residents can use the program. As of May 2020, there were 20,500 flood insurance policies in the state providing $4,074,845,000 in coverage. This figure reveals a roughly 20% decline in policies since 2010, and EGLE estimates that only 15% of all eligible flood-prone structures in the state have coverage. It should be noted that only 50% of all local Michigan communities participate in the NFIP, so there are also thousands of flood-prone structures not eligible for insurance through the program.

As a participant in the NFIP, a community must adopt regulations that: 1) require any new residential construction and substantial improvements to existing structures, within the 100-year floodplain to have the lowest floor, including the basement, elevated above the 100-year flood elevation, 2) require non-residential structures to be elevated or dry floodproofed, and 3) require anchoring of manufactured homes in flood-prone areas. The community must also maintain a record of all lowest floor elevations or the elevations to which buildings in flood hazard areas have been floodproofed.

While the MSP/EMHSD interacts with NFIP data to assist with mitigation planning, EGLE is the primary state department that coordinates with FEMA on the program and its related initiatives (such as Risk MAP, see below). The MSP/EMHSD has created a webpage to help publicize participation in the NFIP and to highlight additional information that can be more routinely provided by EGLE.

Flood Insurance Rate Map (FIRM)

Floodplain maps, including FIRMs, typically display areas that fall within a 100-year flood boundary (the term 100-year flood indicates that the area has a 1% chance of flooding in any given year, not that a flood will occur every 100 years). The term can be misleading because a "100-year" flood may still occur several times a century, due to both random chance, inaccuracies in complex modeling, or changes to an area (e.g., new development, weather patterns) since maps were created.

Risk MAP is a separate flood related FEMA program which also serves as a description of the process used to create flood maps. Its maps and other materials are generally divided between *regulatory* products and *non-regulatory* products. Regulatory products, such as FIRM, are intended to be used as the basis for official actions required by the NFIP. Michiganôs website regarding map updates includes Risk MAP information on newer projects and data. The FEMA Flood Map Service Center used for obtaining maps can be found HERE.

Nationally, it is estimated that about 10% of the properties account for about 40% of all NFIP claims. These properties, which continually receive flood damage and are reimbursed for their insured losses, are referred to as repetitive loss properties and represent important mitigation opportunities.

In an effort to identify and prioritize the most significantly impacted properties, FEMA and Congress have established specific thresholds for designating both repetitive loss properties and severe repetitive loss properties. Along with differences in severity, these classifications are also defined slightly differently across the FMA and NFIP programs themselves. To avoid confusion, it is important to understand the nuances between the similarly sounding terms of the two programs.

Flood Mitigation Assistance (FMA) Repetitive Loss:

A structure covered under NFIP policy that:

a. Has incurred flood-related damage on two occasions, in which the cost of repair, on average, equaled or exceed 25% of the value of the structure at the time of each such flood event, and
b. At the time of the second incidence of flooding-related damage, the contract for flood insurance contains increased cost of compliance coverage.

National Flood Insurance Program (NFIP) Repetitive Loss:

1. A structure that meets one of the two following qualifiers:
    a. Two or more claims of more than $1,000 paid by the NFIP within any rolling 10-year period since 1978.
    b. Two or more claims (building payments only) that, on average, equal or exceed 25% of the market value of the property.
2. A structure covered by a contract for flood insurance made available under the NFIP that meets both of the two following qualifiers:
    a. Has incurred flood-related damage on two occasions, in which the cost of the repair, on average, equaled or exceeded 25% of the market value of the structure at the time of each such flood event.
    b. At the time of the second incidence of flood-related damage, the contract for flood insurance contains increased cost of compliance coverage.

Flood Mitigation Assistance (FMA) Severe Repetitive Loss:

1. A structure that is covered under an NFIP policy and has incurred flood-related damage:
    a. For which four or more separate claims payments have been made under flood insurance coverage with the amount of each claim (including building and contents payments) exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000; or
    b. For which at least two separate flood insurance claims payments (building payments only) have been made, with the cumulative amount of such claims exceeding the value of the insured structure.

National Flood Insurance Program (NFIP) Severe Repetitive Loss:

1. A structure that meets one of the two following qualifiers:
    a. Received four or more separate claim payments of more than $5,000 each (including building and contents payments).
    b. Received two or more separate claim payments (building payments only) where the total of the payments exceeds the current value of the property.
2. A structure covered by a contract for flood insurance made available under the NFIP that has incurred flood-related damage and meets one of the two following qualifiers:
    a. Four or more separate claims payments (includes building and contents) have been made under flood insurance coverage with the amount of each such claim exceeding $5,000 and with the cumulative amount of such claims payments exceeding $20,000.
    b. At least two separate claims payments (includes only building) have been made under such coverage, with the cumulative amount of such claims exceeding the market value of the insured structure.

The MSP/EMHSD is able to access data that identifies properties meeting each of the four designations above using the FEMA Pivot General Support System (Pivot GSS). According to Pivot GSS, as of November 2023, Michigan has the following number of properties in each category:

- The FMA Repetitive Loss properties: 52.
- The NFIP Repetitive Loss properties: 1,012.
- The FMA Severe Repetitive Loss properties: 81.
- The NFIP Severe Repetitive Loss properties: 72.

Note, for the NFIP Repetitive Loss category, Pivot GSS included seven additional properties, but the address data associated with them was errant and/or incomplete. Because their location could not be determined, they were omitted from this total and from the summary on the next page.

For evaluation of Michigan's repetitive loss properties, this plan will focus on the NFIP definition (i.e., NFIP Repetitive Loss). According to the most current Pivot GSS data, 48 of Michigan's 83 counties have structures that had suffered from repetitive flood claims. The following list shows the distribution of these structures by county and specifies the communities within each county that contain these repetitive loss properties.

The NFIP Repetitive Loss Property Summary (Michigan)

County Name	Community Name	Total
ALCONA COUNTY	GREENBUSH, TOWNSHIP OF	1
ALCONA COUNTY Total		**1**
ALLEGAN COUNTY	LAKETOWN, TOWNSHIP OF	1
	SAUGATUCK, CITY OF	2
ALLEGAN COUNTY Total		**3**
ARENAC COUNTY	ARENAC, TOWNSHIP OF	3
	AUGRES, CITY OF	1
	DEEP RIVER, TOWNSHIP OF	1
	STANDISH, TOWNSHIP OF	2
ARENAC COUNTY Total		**7**
BARRY COUNTY	CASTLETON, TOWNSHIP OF	22
	HASTINGS, TOWNSHIP OF	7
	HOPE, TOWNSHIP OF	1
	NASHVILLE, VILLAGE OF	1
	RUTLAND, TOWNSHIP OF	1
	THORNAPPLE, TOWNSHIP OF	4
	YANKEE SPRINGS, TOWNSHIP OF	1
BARRY COUNTY Total		**37**
BAY COUNTY	BANGOR, CHARTER TOWNSHIP OF	19
	BAY CITY, CITY OF	8
	KAWKAWLIN, TOWNSHIP OF	9
	PINCONNING, TOWNSHIP OF	1
	SAGINAW, CHARTER TOWNSHIP OF	1
	WILLIAMS, TOWNSHIP OF	1
BAY COUNTY Total		**39**
BERRIEN COUNTY	BARODA, TOWNSHIP OF	1
	COLOMA, CHARTER TOWNSHIP OF	4
	HAGAR, TOWNSHIP OF	1
	NILES,CITY OF	2
	ROYALTON, TOWNSHIP OF	5
	ST. JOSEPH, CHARTER TOWNSHIP OF	2
	WATERVLIET, CITY OF	1
	WEESAW, TOWNSHIP OF	1
BERRIEN COUNTY Total		**17**
BRANCH COUNTY	COLDWATER, CITY OF	3
	COLDWATER, TOWNSHIP OF	1
	QUINCY, TOWNSHIP OF	1
BRANCH COUNTY Total		**5**
CALHOUN COUNTY	BATTLE CREEK, CITY OF	3
	EMMETT, TOWNSHIP OF	2
CALHOUN COUNTY Total		**5**
CASS COUNTY	SILVER CREEK, TOWNSHIP OF	1
CASS COUNTY Total		**1**

County Name	Community Name	Total
CLINTON COUNTY	VICTOR, TOWNSHIP OF	1
	WATERTOWN, CHARTER TOWNSHIP OF	2
CLINTON COUNTY Total		**3**
DICKINSON COUNTY	KINGSFORD, CITY OF	1
DICKINSON COUNTY Total		**1**
EATON COUNTY	CASTLETON, TOWNSHIP OF	1
	DELTA, CHARTER TOWNSHIP OF	2
	DIMONDALE, VILLAGE OF	1
	EATON RAPIDS, CITY OF	1
	EATON RAPIDS, TOWNSHIP OF	1
	WINDSOR, CHARTER TOWNSHIP OF	8
EATON COUNTY Total		**14**
GENESEE COUNTY	BURTON, CITY OF	8
	FLINT, CITY OF	21
	FLINT, TOWNSHIP OF	1
	FLUSHING, TOWNSHIP OF	2
	GAINES, TOWNSHIP OF	1
	GENESEE, TOWNSHIP OF	3
	GRAND BLANC, CITY OF	2
	GRAND BLANC, TOWNSHIP OF	3
GENESEE COUNTY Total		**41**
GLADWIN COUNTY	HAY, TOWNSHIP OF	5
GLADWIN COUNTY Total		**5**
GRAND TRAVERSE COUNTY	BLAIR, TOWNSHIP OF	1
	GARFIELD, CHARTER TOWNSHIP OF	1
GRAND TRAVERSE COUNTY Total		**2**
HOUGHTON COUNTY	CHASSELL, TOWNSHIP OF	1
HOUGHTON COUNTY Total		**1**
HURON COUNTY	FAIRHAVEN, TOWNSHIP OF	1
	MCKINLEY, TOWNSHIP OF	1
HURON COUNTY Total		**2**
INGHAM COUNTY	EAST LANSING, CITY OF	4
	LANSING, CHARTER TOWNSHIP OF	1
	LANSING, CITY OF	3
	MASON, CITY OF	1
	MERIDIAN, CHARTER TOWNSHIP OF	4
INGHAM COUNTY Total		**13**
IONIA COUNTY	IONIA, CITY OF	2
IONIA COUNTY Total		**2**
IOSCO COUNTY	AU SABLE, TOWNSHIP OF	2
IOSCO COUNTY Total		**2**
ISABELLA COUNTY	NOTTAWA, TOWNSHIP OF	1
	SPRING LAKE, TOWNSHIP OF	1
	UNION, CHARTER TOWNSHIP OF	1

County Name	Community Name	Total
ISABELLA COUNTY Total		**3**
JACKSON COUNTY	JACKSON, CITY OF	2
	NAPOLEON, TOWNSHIP OF	1
	SUMMIT, TOWNSHIP OF	1
JACKSON COUNTY Total		**4**
KALAMAZOO COUNTY	COMSTOCK, CHARTER TOWNSHIP OF	3
	KALAMAZOO, CHARTER TOWNSHIP OF	3
	KALAMAZOO, CITY OF	15
	PORTAGE, CITY OF	1
	TEXAS, CHARTER TOWNSHIP OF	1
KALAMAZOO COUNTY Total		**23**
KENT COUNTY	ADA, TOWNSHIP OF	5
	ALGOMA, TOWNSHIP OF	3
	CALEDONIA, CHARTER TOWNSHIP OF	2
	EAST GRAND RAPIDS, CITY OF	1
	GRAND RAPIDS, CITY OF	14
	GRANDVILLE, CITY OF	6
	LOWELL, CITY OF	4
	PLAINFIELD, CHARTER TOWNSHIP OF	24
	SPARTA, VILLAGE OF	1
	TALLMADGE, CHARTER TOWNSHIP OF	1
	WYOMING, CITY OF	7
KENT COUNTY Total		**68**
LAKE COUNTY	CHERRY VALLEY, TOWNSHIP OF	1
	PLEASANT PLAINS, TOWNSHIP OF	7
LAKE COUNTY Total		**8**
LENAWEE COUNTY	ADRIAN, CITY OF	1
	BLISSFIELD, VILLAGE OF	4
	DEERFIELD, TOWNSHIP OF	1
	DEERFIELD, VILLAGE OF	1
LENAWEE COUNTY Total		**7**
LIVINGSTON COUNTY	GREEN OAK, TOWNSHIP OF	2
	HAMBURG, TOWNSHIP OF	5
	PUTNAM, TOWNSHIP OF	1
LIVINGSTON COUNTY Total		**8**
MACOMB COUNTY	CHESTERFIELD, TOWNSHIP OF	4
	CLINTON, CHARTER TOWNSHIP OF	7
	HARRISON, TOWNSHIP OF	14
	MACOMB, TOWNSHIP OF	4
	MOUNT CLEMENS, CITY OF	1
	NEW BALTIMORE, CITY OF	3
	SHELBY, CHARTER TOWNSHIP OF	2
	ST. CLAIR SHORES, CITY OF	4
	STERLING HEIGHTS, CITY OF	2

County Name	Community Name	Total
	UTICA, CITY OF	3
	WARREN, CITY OF	1
MACOMB COUNTY Total		**45**
MANISTEE COUNTY	ONEKAMA, TOWNSHIP OF	1
MANISTEE COUNTY Total		**1**
MARQUETTE COUNTY	CHOCOLAY, CHARTER TOWNSHIP OF	2
MARQUETTE COUNTY Total		**2**
MASON COUNTY	MEADE, TOWNSHIP OF	1
MASON COUNTY Total		**1**
MECOSTA COUNTY	BIG RAPIDS, CITY OF	1
	BIG RAPIDS, TOWNSHIP OF	1
	FORK, TOWNSHIP OF	3
	MECOSTA, TOWNSHIP OF	3
MECOSTA COUNTY Total		**8**
MENOMINEE COUNTY	INGALLSTON, TOWNSHIP OF	1
	MENOMINEE COUNTY *	1
MENOMINEE COUNTY Total		**2**
MIDLAND COUNTY	HOMER, TOWNSHIP OF	4
	MIDLAND, CITY OF	107
	MIDLAND, TOWNSHIP OF	2
	SANFORD, VILLAGE OF	7
MIDLAND COUNTY Total		**120**
MONROE COUNTY	BEDFORD, TOWNSHIP OF	2
	BERLIN, CHARTER TOWNSHIP OF	8
	DUNDEE, VILLAGE OF	4
	ERIE, TOWNSHIP OF	9
	ESTRAL BEACH, VILLAGE OF	9
	FRENCHTOWN, CHARTER TOWNSHIP OF	18
	LASALLE, TOWNSHIP OF	39
	LUNA PIER, CITY OF	2
	MONROE, CHARTER TOWNSHIP OF	14
	MONROE, CITY OF	5
	NEWTON, TOWNSHIP OF	1
MONROE COUNTY Total		**111**
MUSKEGON COUNTY	LAKETON, TOWNSHIP OF	1
	MUSKEGON, CITY OF	2
	NORTON SHORES, CITY OF	2
MUSKEGON COUNTY Total		**5**
NEWAYGO COUNTY	ASHLAND, TOWNSHIP OF	2
	BRIDGETON, TOWNSHIP OF	8
	BROOKS, TOWNSHIP OF	1
	GARFIELD, TOWNSHIP OF	3
	NEWAYGO, CITY OF	1
NEWAYGO COUNTY Total		**15**

County Name	Community Name	Total
OAKLAND COUNTY	BIRMINGHAM, CITY OF	2
	FARMINGTON HILLS, CITY OF	13
	TROY, CITY OF	3
	WATERFORD, CHARTER TOWNSHIP OF	5
	WEST BLOOMFIELD, TOWNSHIP OF	1
OAKLAND COUNTY Total		**24**
OSCEOLA COUNTY	EVART, TOWNSHIP OF	2
	MARION, VILLAGE OF	1
	OSCEOLA, TOWNSHIP OF	2
OSCEOLA COUNTY Total		**5**
OTTAWA COUNTY	GEORGETOWN, CHARTER TOWNSHIP OF	3
	HOLLAND, CHARTER TOWNSHIP OF	4
	PARK, TOWNSHIP OF	4
	ROBINSON, TOWNSHIP OF	10
	SPRING LAKE, TOWNSHIP OF	1
	WRIGHT, TOWNSHIP OF	1
	ZEELAND, CITY OF	1
OTTAWA COUNTY Total		**24**
SAGINAW COUNTY	BRIDGEPORT, CHARTER TOWNSHIP OF	1
	BUENA VISTA, CHARTER TOWNSHIP OF	2
	CARROLLTON, TOWNSHIP OF	3
	JAMES, TOWNSHIP OF	7
	SAGINAW, CHARTER TOWNSHIP OF	9
	SAGINAW, CITY OF	8
	SPAULDING, TOWNSHIP OF	6
	ST. CHARLES, VILLAGE OF	2
	THOMAS, TOWNSHIP OF	5
	TITTABAWASEE, TOWNSHIP OF	4
SAGINAW COUNTY Total		**47**
SHIAWASSEE COUNTY	CALEDONIA, CHARTER TOWNSHIP OF	1
	OWOSSO, CITY OF	1
SHIAWASSEE COUNTY Total		**2**
ST. CLAIR COUNTY	ALGONAC, CITY OF	9
	BURTCHVILLE, TOWNSHIP OF	1
	CHINA, CHARTER TOWNSHIP OF	3
	CLAY, TOWNSHIP OF	15
	COTTRELLVILLE, TOWNSHIP OF	2
	EAST CHINA, CHARTER TOWNSHIP OF	13
	FAIRHAVEN, TOWNSHIP OF	3
	FORT GRATIOT, CHARTER TOWNSHIP OF	6
	IRA, TOWNSHIP OF	8
	KIMBALL, TOWNSHIP OF	1
	MARINE CITY, CITY OF	7
	PORT HURON, CITY OF	4

County Name	Community Name	Total
ST. CLAIR COUNTY Total		**72**
ST. JOSEPH COUNTY	COLON, VILLAGE OF	2
	NOTTAWA, TOWNSHIP OF	1
	THREE RIVERS, CITY OF	4
ST. JOSEPH COUNTY Total		**7**
TUSCOLA COUNTY	TUSCOLA, TOWNSHIP OF	1
	VASSAR, CITY OF	6
	WISNER, TOWNSHIP OF	5
TUSCOLA COUNTY Total		**12**
VAN BUREN COUNTY	COVERT, TOWNSHIP OF	1
	SOUTH HAVEN, CITY OF	2
VAN BUREN COUNTY Total		**3**
WASHTENAW COUNTY	ANN ARBOR, CITY OF	4
	NORTHFIELD, TOWNSHIP OF	4
	YPSILANTI, CITY OF	1
WASHTENAW COUNTY Total		**9**
WAYNE COUNTY	ALLEN PARK, CITY OF	8
	BROWNSTOWN, CHARTER TOWNSHIP OF	5
	DEARBORN HEIGHTS, CITY OF	55
	DEARBORN, CITY OF	1
	DETROIT, CITY OF	64
	ECORSE, CITY OF	7
	FRENCHTOWN, CHARTER TOWNSHIP OF	1
	GIBRALTAR, CITY OF	5
	GROSSE ILE, TOWNSHIP OF	4
	GROSSE POINTE PARK, CITY OF	1
	LINCOLN PARK, CITY OF	7
	PLYMOUTH, CHARTER TOWNSHIP OF	1
	PLYMOUTH, CITY OF	1
	REDFORD, TOWNSHIP OF	7
	ROMULUS, CITY OF	1
	TAYLOR, CITY OF	3
	TRENTON, CITY OF	2
	WESTLAND, CITY OF	1
	WYANDOTTE, CITY OF	1
WAYNE COUNTY Total		**175**
Grand Total		**1012**

*County is identifiable from Pivot GSS data but is missing a specific community location.

For evaluation of Michigan's severe repetitive loss properties, this plan will focus on the NFIP definition (i.e., NFIP Severe Repetitive Loss). According to the most current Pivot GSS data, 24 of Michigan's 83 counties have structures that meet the NFIP designation of severe repetitive loss. The following list shows the distribution of these structures by county and specifies the communities within each county that contain these severe repetitive loss properties.

The NFIP Severe Repetitive Loss Property Summary (Michigan)

County Name	Community Name	Total
ARENAC COUNTY	ARENAC, TOWNSHIP OF	1
ARENAC COUNTY Total		**1**
BARRY COUNTY	CASTLETON, TOWNSHIP OF	2
	THORNAPPLE, TOWNSHIP OF	1
BARRY COUNTY Total		**3**
BAY COUNTY	BANGOR, CHARTER TOWNSHIP OF	1
BAY COUNTY Total		**1**
BERRIEN COUNTY	HAGAR, TOWNSHIP OF	1
BERRIEN COUNTY Total		**1**
CLINTON COUNTY	VICTOR, TOWNSHIP OF	1
CLINTON COUNTY Total		**1**
GENESEE COUNTY	FLINT, CITY OF	1
	FLUSHING, TOWNSHIP OF	1
	GENESEE, TOWNSHIP OF	1
	GRAND BLANC, TOWNSHIP OF	1
GENESEE COUNTY Total		**4**
GLADWIN COUNTY	HAY, TOWNSHIP OF	1
GLADWIN COUNTY Total		**1**
KALAMAZOO COUNTY	KALAMAZOO, CHARTER TOWNSHIP OF	1
	KALAMAZOO, CITY OF	4
KALAMAZOO COUNTY Total		**5**
KENT COUNTY	ADA, TOWNSHIP OF	3
	GRAND RAPIDS, CITY OF	1
	PLAINFIELD, CHARTER TOWNSHIP OF	2
	SPARTA, VILLAGE OF	1
	TALLMADGE, CHARTER TOWNSHIP OF	1
KENT COUNTY Total		**8**
LAKE COUNTY	CHERRY VALLEY, TOWNSHIP OF	1
LAKE COUNTY Total		**1**
LIVINGSTON COUNTY	HAMBURG, TOWNSHIP OF	1
LIVINGSTON COUNTY Total		**1**
MACOMB COUNTY	CLINTON, CHARTER TOWNSHIP OF	1
	HARRISON, TOWNSHIP OF	1
MACOMB COUNTY Total		**2**
MECOSTA COUNTY	FORK, TOWNSHIP OF	1
MECOSTA COUNTY Total		**1**
MIDLAND COUNTY	MIDLAND, CITY OF	1
	SANFORD, VILLAGE OF	2
MIDLAND COUNTY Total		**3**
MONROE COUNTY	BERLIN, CHARTER TOWNSHIP OF	1
	ERIE, TOWNSHIP OF	1
	ESTRAL BEACH, VILLAGE OF	1
	FRENCHTOWN, CHARTER TOWNSHIP OF	3
	LASALLE, TOWNSHIP OF	2
	MONROE, CHARTER TOWNSHIP OF	2
MONROE COUNTY Total		**10**

County Name	Community Name	Total
NEWAYGO COUNTY	ASHLAND, TOWNSHIP OF	1
	GARFIELD, TOWNSHIP OF	1
NEWAYGO COUNTY Total		**2**
OAKLAND COUNTY	FARMINGTON HILLS, CITY OF	4
OAKLAND COUNTY Total		**4**
OTTAWA COUNTY	ROBINSON, TOWNSHIP OF	3
OTTAWA COUNTY Total		**3**
SAGINAW COUNTY	SAGINAW, CHARTER TOWNSHIP OF	2
	SAGINAW, CITY OF	4
	TITTABAWASEE, TOWNSHIP OF	1
SAGINAW COUNTY Total		**7**
ST. CLAIR COUNTY	BURTCHVILLE, TOWNSHIP OF	1
	CLAY, TOWNSHIP OF	2
	IRA, TOWNSHIP OF	1
ST. CLAIR COUNTY Total		**4**
ST. JOSEPH COUNTY	THREE RIVERS, CITY OF	2
ST. JOSEPH COUNTY Total		**2**
TUSCOLA COUNTY	VASSAR, CITY OF	1
TUSCOLA COUNTY Total		**1**
WASHTENAW COUNTY	ANN ARBOR, CITY OF	1
WASHTENAW COUNTY Total		**1**
WAYNE COUNTY	BROWNSTOWN, CHARTER TOWNSHIP OF	1
	DEARBORN HEIGHTS, CITY OF	1
	DEARBORN, CITY OF	1
	GIBRALTAR, CITY OF	2
WAYNE COUNTY Total		**5**
Grand Total		**72**

Repetitive Loss Mitigation Efforts

Michigan encourages communities to initiate actions to reduce the number of repetitive loss properties. The MCCERCC HMC prioritizes the use of HMA funds for projects that will mitigate such properties. In the scoring of HMA applications for funding priority ranking (see Chapter 5), additional points will be granted to applications that address repetitive loss properties. To date, 43 of Michigan's completed HMA grants were for the acquisition of flood prone properties (184 individual properties acquired). Another nine HMA projects are currently on-going for the acquisition of 122 properties. Not all of those properties are currently or in the past strictly classified as NFIP Repetitive Loss properties but a significant share of them are.

Michigan has successfully used HMA grant funds over the years to mitigate repetitive loss properties. To date, nine HMA grants have been utilized to acquire, demolish, and deed restrict 17 of the properties on Michigan's current NFIP repetitive loss list, including:

- Dearborn Heights - 4 properties acquired with the use of 4195 HMGP and 2016 PDM.
- Genesee County - 1 property acquired with the use of 1527 HMGP.
- Grand Blanc - 1 property acquired with the use of 1346 HMGP.
- Macomb County - 3 properties acquired with the use of 1346 HMGP.
- Sanford - 4 properties acquired with the use of 4195 HMGP and 4326 HMGP.
- Robinson Township - 3 properties acquired with the use of 2005 PDM.
- Rutland Township - 1 property acquired with the use of 1527 HMGP.

Michigan also has five ongoing HMA grants as of November 2023 that include scopes of work which will, if successful, result in the mitigation of 15 additional repetitive loss properties. The grants are property acquisitions in Allen Park, Dearborn Heights, Grand Rapids, Midland, and Plainfield Township.

There are several challenges with grants for the acquisition of repetitive loss properties. The most significant is that communities find it difficult to provide local matching dollars for these types of hazard mitigation projects. Identifying a match for mitigation projects, in general, can be challenging but is more so for acquisition grants because using community general funds can be seen as using local tax dollars to benefit only a few specific people (the owners of the homes being acquired). There is a community wide benefit to removing flood prone properties from a floodplain, but it is not always viewed as such in the eyes of the public.

Another challenge for acquiring these properties can be the voluntary nature of HMA acquisition projects. Owners of properties identified for acquisition through HMA grants have the opportunity to decline participation right up until the time of program purchase. Numerous repetitive loss properties have therefore been slated for HMA acquisition over the years but with owners ultimately deciding not to sell (resulting in properties continuing to show up as unmitigated on the NFIP Repetitive Loss list).

Michigan will continue to prioritize the implementation of projects that mitigate repetitive loss of properties and encourage communities to pursue such projects. The HMA and STRLF funding decisions will consider repetitive loss properties when scoring and ranking project applications. The MSP/EMHSD staff will at least annually, and following flooding disasters, review repetitive and severe repetitive loss properties data to inform outreach strategies. The state will prioritize related educational outreach efforts to communities with the most repetitive and severe repetitive loss properties. Additionally, the state will assist communities with messaging development to educate the public about the community wide benefits of these activities.

Appendix 6: Land Use Laws and Building Codes

The FEMA requires a description and evaluation of land use and building code laws for the state. A comprehensive planning process can use such regulations to reduce risk and vulnerability for many types of hazards. While these can be part of effective strategies, any evaluation of these topics must also consider the political, social, and economic pressure at the local level that may result in land use decisions that don't further the goals of hazard mitigation. Funding may also not be available to support qualified planners and code enforcement, or a community may not support such activities.

Planning Commissions and Comprehensive Planning

Land use and development guidance are coordinated, at least to some degree, by a local planning commission. In Michigan, local and regional planning commissions are authorized through the Michigan Planning Enabling Act 33 of 2008, to develop, review, and implement long-term development plans. Although local planning commissions in Michigan are primarily advisory bodies as opposed to regulatory, they may still wield power or influence in certain decisions. Similarly, regional planning commissions have the authority to review and comment on local federally funded development projects, which also places them in a position to offer insight on possible mitigation opportunities within or affecting local jurisdictions.

A comprehensive planning effort supports mitigation. The purpose of a comprehensive plan is to establish an orderly, convenient, efficient, and enjoyable environment for a community, improving the quality of life for its citizens. A comprehensive plan provides for the future development or improvement of the land use patterns of a community. In Michigan, planning commissions are required to prepare and adopt a comprehensive plan if the community is enforcing a zoning ordinance (the zoning ordinance must be based on an adopted comprehensive plan to be legally defensible and enforceable). Once adopted by a planning commission and/or the community's legislative body, the comprehensive plan serves as the foundation document for the preparation and subsequent implementation of other land use and development measures such as zoning.

In terms of content, comprehensive plans typically address such subjects as land use, transportation, utilities, schools, public facilities, parks, economic development, and other subjects that relate to the physical development of the community. Although there are no absolute required elements for comprehensive plans in Michigan, 2006 PA 110 (Michigan Zoning Enabling Act) does provide specific guidance with regard to the types of zoning districts that may be established. Section 201(1) of the Act states: "A local unit of government may provide by zoning ordinance for the regulation of land development and the establishment of one or more districts within its zoning jurisdiction which regulate the use of land and structures to meet the needs of the state's citizens for food, fiber, energy, and other natural resources, places of residence, recreation, industry, trade, service, and other uses of land, to ensure that use of the land is situated in appropriate locations and relationships, to limit the inappropriate overcrowding of land and congestion of population, transportation systems, and other public facilities, to facilitate adequate and efficient provision for transportation systems, sewage disposal, water, energy, education, recreation, and other public service and facility requirements, and to promote public health, safety, and welfare."

The Michigan Zoning Enabling Act, especially Section 201(3) (see below), provides a regulatory framework to allow communities to effectively use comprehensive planning and zoning to reduce their natural hazard risk and vulnerability. In communities where comprehensive planning is not done, the building code (see below) is often the only land use regulatory measure available.

Additional Zoning Considerations

Section 201(3) of the Zoning Enabling Act provides for the establishment of zoning districts to address special land use problems or achieve specific land management objectives. It states: "A local unit of government may provide under the zoning ordinance for the regulation of land development and the establishment of districts which apply only to land areas and activities involved in a special program to achieve specific land management objectives and avert or solve specific land use problems, including the regulation of land development and the establishment of districts in areas subject to damage from flooding or beach erosion."

This allows for such activities as floodplain management under the NFIP and coastal zone management under the Michigan Natural Resources and Environmental Protection Act (1994 PA 451, as amended). Although the Act specifically mentions flooding and beach erosion hazards as examples, the provision is flexible enough to address other known hazard areas in a community as long as the regulatory measure is legally defensible and consistently applied.

Zoning ordinances provide a mechanism for implementing the policy decisions articulated in a comprehensive plan concerning the desired locations of various land uses and public facilities. Because the zoning ordinance is based on the comprehensive plan it is therefore developed and adopted after the comprehensive plan has been formally adopted. Generally, the comprehensive plan is designed to guide development for the next 20 years or more, whereas the zoning ordinance will typically be adopted on the basis of a 7 to 10-year land use development need projection.

A zoning ordinance typically addresses three primary areas: 1) the use of land and structures and the height and bulk of structures, 2) the density of population and intensity of land and structural use, and 3) the provision for space around structures (i.e., requirements for side yards, rear yards, open space, building setback lines, etc.). Some zoning ordinances may specifically address potential hazards to life and property, although there is no requirement to do this. The ordinance itself consists of a map or maps delineating the zoning districts in the community where various land uses will be allowed, and an accompanying set of administrative procedures, standards, and methods for enforcing the zoning regulations. Zoning districts typically include various types of industrial, commercial, residential, agricultural, and public facility uses.

Although there are a variety of standard zoning districts, there are no formal legal requirements regarding the type of districts that must be included in an ordinance. As indicated in the "Comprehensive Planning" section above, the new Michigan Zoning Enabling Act is suggestive but not prescriptive in its provisions for zoning districts (Section 201 (1)). It is up to each planning commission to determine the type of zoning districts that are appropriate for the community, based on its unique characteristics. While local zoning can be beneficial and allows for retention of local power, a downside is that it is not used in all communities. It also means limited central information exists. Some recement information was compiled by the State and the University of Michigan-Graham Sustainability Institute for the purpose of analyzing renewable energy siting. An interactive lookup map includes data that was valid as of July 27, 2022.

Building Codes

Building codes are designed to ensure that a building or other structure will be constructed in such a manner as to be safe for occupancy and use. These codes also regulate health and sanitation requirements for water, ventilation, plumbing, electricity, mechanical equipment, heating, and air conditioning. They also contain minimum construction standards for natural hazard resistance. They can be effective in reducing or eliminating damage caused by many types of hazards such as high winds, fire, and flooding.

Pursuant to 1972 PA 230, as amended, all communities in Michigan are subject to the State Construction Code, which establishes general minimum construction standards for buildings and structures in all Michigan municipalities. The State Construction Code is a compilation of the International Residential Code, the International Building Code, the International Mechanical Code, the International Plumbing Code published by the International Code Council, the National Electrical Code published by the National Fire Prevention Association, and the Michigan Uniform Energy Code with amendments, additions, or deletions as the Michigan Department of Energy, Labor and Economic Growth determines appropriate. The State Construction Code provides for statewide uniformity of application and implementation of rules governing the construction, use, and occupancy of buildings and structures.

The FEMA tracks building code status in order to evaluate several important aspects of a community's adoption. A national building code portal is an excellent tool for examining Michigan's status as compared to natural hazard risk. As of November 2023, Michigan is generally shown as having a combined status of "old or weakened codes" as it is still in the process of legally adopting new codes for the state (most codes are currently based on 2015 standards). At the time of this writing, it is expected that newer 2021 building code standards will be adopted sometime in 2024. Readers should consult the portal for the most up to date information. Another reason the state may not rate higher in some areas is because it does not have storm shelter requirements for "category e" buildings despite the fact that many parts of the Lower Peninsula are considered to be in a high wind area for tornadoes.

Provisions of the State Construction Code and other building codes are enforced through authorized local building inspection agencies and state inspectors. In Michigan, there is a large number of registered local inspectors and many state inspectors. The Skilled Trades Regulation Act, 2016 PA 407, requires all building inspectors to be registered with the State and continue training throughout their careers. Training sessions conducted by the Bureau of Construction Codes are required for all building code Inspectors. Following the training sessions, evaluations are given in order to set high standards for the quality of building inspectors in Michigan. The Bureau of Construction Codes also evaluates the performance of a community's building inspection and enforcement effort. These performance evaluations are usually done when a community requests an audit or when a complaint is filed by a private citizen.

Appendix 7: Local Planning Activities and County Reviews

While local hazard mitigation planning may have challenges for success, the MSP/EMHSD also acknowledges that opportunities for mitigation are often best executed at the local level (see Chapter 6). Steps and activities that have been taken to remove these barriers are discussed below, and the hazard analyses and mitigation strategies from County Hazard Mitigation Plans have been individually summarized. These materials have been used to help inform the MHMP.

Section 1: Recent Support Activities

The MSP/EMHSD provides technical assistance, presentations, workshops, research, and other forms of "hands-on" assistance with local planning processes, including helping communities to secure grant funding for mitigation planning. The MSP/EMHSD Local Planner responsible for these duties has been involved in the update of this state plan, including the consideration of all approved local mitigation plans and planning draft materials on file. Some previous work was also done by a second hazard mitigation planner, when available, who served as an additional local plan reviewer. The most recent such planner left employment in 2019.

Between the 2019 MHMP and this current 2024 edition, various meetings, presentations, conference calls, and other outreach were participated in or led by MSP/EMHSD planning staff in support of local hazard mitigation planning (not including more routine phone calls and emails that still frequently involved data compilation and planning instruction). This period also involved the issuance of new FEMA policy guidance for local hazard mitigation plans. The following material below the highlighted box provides select details of activities through which staff have continued to specifically support the development of local hazard mitigation plans (in addition to its training, grant coordination, and emergency management program support roles).

Staff outreach to promote hazard mitigation planning among local emergency management programs, local officials, other professionals, and the general public (April 2019 to November 2023). Note: References to "districts" refer to MSP/EMHSD's eight districts unless otherwise specified, while references to "regions" refer to Michigan's 14 regional planning organizations. A shorthand abbreviation as used in this section: D for district and R for region, followed by the number of that district or region (e.g., D2N means MSP/EMHSD District 2N, while R2 means planning region 2).

On April 22, 2019, the previous MHMP update was completed and officially approved by FEMA. The revised MHMP was then posted on a public website to allow anyone to peruse it and provide feedback. Inquiries were made regarding Arenac County planning progress, correctly concerned that the county's planning grant would lapse without successful plan completion (it was later completed in 2023). By contrast, it was confirmed that the University of Michigan was on track to complete a plan for all three of its major campuses by the end of 2019. Arrangements were made for instructional planning presentations at all MSP/EMHSD district meetings throughout the state. Although the COVID-19 pandemic prevented the full set of district meeting appearances that are normally planned each year, a complete set did occur during 2019, before the pandemic affected Michigan. Those 2019 meetings included D1 in the City of Mason (November 21), D2N and D2S in the City of Taylor (September 10), D3 in Bay City (October 14), D5 in the City of Paw Paw (November 26), D6 in the City of Big Rapids (August 26), D7 in the City of Grayling (October 3), and D8 in the City of Marquette (November 7). During the pandemic, a round of similar presentations was almost completed in 2021, covering D1 on July 22, D2 on September 7, D3 on August 26, D5 on September 28, D6 on August 23, and D8 on July 13 of that year. Additional outreach is planned to resume in 2024, in conjunction with the update of MSP/EMHSD Pub. 207.

The last live pre-pandemic presentation of the hazard mitigation planning module in MI-CEMKR (MSP/EMHSD's Critical Emergency Management Knowledge course) occurred on February 19, 2020. A video recording was made of the hazard mitigation planning module for MI-CEMKR on August 13, 2021, and presented virtually along with later question and answer session in subsequent course offerings (e.g., December 2, 2021, April 27, 2022, October 24, 2022).

Additional presentations were provided upon request and through coordination with other agencies. These included county board presentations to Arenac County on July 15, 2021, and Oscoda County on September 12, 2021. A conference webinar on resilience principles was provided at Michigan State University conference on April 21, 2021. A guest lecture occurred in person (with mask use) at a University of Michigan planning course on October 25, 2021. A webinar was provided on hazard mitigation planning on April 21, 2022. On April 26, 2022, a presentation on hazard mitigation planning was given at a teleconference of the Michigan Townships Association. A presentation was provided at a planning kickoff meeting for Charlevoix County on August 15, 2022, and an in-person presentation on hazard

mitigation was given on October 11, 2022, at a MEMA annual conference. During the pandemic, virtual presentations were the norm, and various virtual formats were used on most of these dates. Known FEMA training occurred on November 4, 2020, and December 9, 2021, and also through several Risk MAP meetings in late 2020. FEMA open house meetings were part of their outreach to locals about hazards in specific areas.

Required local plan information about NFIP repetitive-flood-claim properties was previously provided upon request by MSP/EMHSD staff, using information provided by EGLE or FEMA. For example, such information was provided by MSP/EMHSD upon request to the planners for Berrien County in December 2021. However, a change occurred at the federal level that required communities to directly request this information from FEMA by following specific instructions to contact them and sign a non-disclosure form for sensitive elements of insurance-derived information. Sometimes, plan approvals have been held up by delays in FEMAôs provision of that required information for consideration within the local plans. However, it was often found that when this information was the only thing still required to pass review, FEMA was able to internally locate and transfer that information to plan reviewers and planning consultants as the final step to meet the planning requirements, with plan approval soon following.

As part of plan review feedback, phone calls and teleconferences were arranged with various local programs. For example, a Montcalm County call occurred on August 14, 2019, a Wayne County conference call occurred on August 20, 2019, and an R13 planning call occurred on September 9, 2019. More than a dozen such calls have been documented through the end of 2021, 47 such calls occurred during 2022, and at least 11 such calls occurred during 2023. Some of these sessions lasted several hours in length. They provided ways to help explain and work through planning processes that would have been too difficult to convey and interpret in purely written forms.

Most EMPG related local emergency management programs were individually contacted during the five-year period as a part of their local plan update processes. An article was published in a 2019 MSP/EMHSD newsletter, describing the top Michigan hazards identified in the 2019 MHA and helping build awareness of available data resources. Another article was published in the December 2022 newsletter regarding changes in FEMA planning policy.

Planning assistance will continue throughout the five-year period (2024-2029) covered by this newly updated plan. These planning efforts are supplemented by educational activities delivered by MSP/EMHSD (such as the MI-CEMKR training course), the provision of guidance materials, the administration of available HMA grants, and the routine processing of adoption resolutions, FEMA reviews, and FEMA approval letters.

Section 2: Local Risks and Mitigation Strategies As Determined From Local Plans

An important component for updating a state mitigation plan includes an understanding of local mitigation plan contents. As a state-level plan, the MHMP focuses primarily on issues and concerns of a statewide or regional nature and much of its scope may by necessity be of a broad nature. The local plan review process provides an opportunity for the state to better understand hazards that may be having more a significant impact at the local level. It also allows for the spotting of trends, although it should be noted that differences in the standards used in many local plans is different than those used in the MHMP. For example, FEMA local planning standards only require natural hazards to be assessed. This results in many local plans not considering as many technological or human-related hazards. In addition, local agencies tend to give the highest priority to the protection of human life, while federal hazard mitigation standards are most clearly defined when describing the mitigation of property damage.

An overview is provided below for each Michigan county for which relevant information about various hazards was available within local plans. There were many counties for which information about hazard prioritization was not available in sufficient quality to support further analysis of that comparative type. Nevertheless, some attempts have been made in this section to evaluate and compare local vulnerabilities, despite the fact that the effective comparison of risks more properly requires an elaborate method by which different types of impacts and probabilities can be validly estimated and weighed against each other in conjunction with a consideration of mitigation capabilities (and established program priorities across multiple levels of government). To the extent this can be achieved for Michiganôs natural hazards, it can be best reviewed in the NCEI database information presented on a county basis in the MHA or as regionally summarized in Chapter 4 of this publication.

County mitigation strategies were also considered as additional opportunities to help inform the MHMP and the needs of its Action Plan. The information in this section can be taken as representing important concerns from local hazard mitigation plans and indicative of county jurisdictions within the state that have specific vulnerabilities that could be addressed by state assistance. While details of hazard vulnerabilities involving local communities, local hazard areas, and local facilities should primarily be addressed in local hazard mitigation plans, there will be some local mitigation strategies that may spur state innovation or that can be recognized by the state as needing to be shared with other communities through educational efforts. It is also at the local level that zoning and land use planning takes place, and where local resources and information regarding local roads, drains, and culverts can be found.

Consideration was especially given to the following types of information during review:

- Vulnerable residential and commercial structures in floodplains and other hazard areas (where substantial enough to suggest a need for state assistance or awareness).
- Significant historical events and their associated loss estimates.
- Land use trends and associated areas of concern where development may overlap with identified floodplains and other hazard areas.
- Specific mitigation projects coinciding directly with state goals and objectives (or that demonstrated concerns serious enough to warrant consideration at the state or federal level).

The following material summarizes information that had been presented in local hazard mitigation plans (or submitted draft plans) for all 83 of Michigan's counties. Those counties that have updated their plan since the spring of 2019 have had their descriptive text updated in the following pages. The text was duplicated from the 2019 edition of the MHMP where no local plan update had since occurred (and therefore still reflects the most current plan on file).

County Plan Informational Summaries:

ALCONA COUNTY – Their plan was last approved in March 2022. The wildfire hazard was still identified in their updated local plan as the most significant facing the county. About 36% of the county has high-risk forest/fuel types such as jack pine, red pine, white pine, pine barrens, and pine/oak barrens. Large areas of the county are forested and at similar risk, rather than a few specific vulnerable areas. The Alcona plan notes that 973 acres had been burned by wildfires since 2001 in the county, which contains part of the Huron National Forest. The county's local plan has also identified infrastructure failures, winter weather (both ice and snow), severe winds, and drought as top hazards, followed by public health emergencies, extreme temperatures, dam failure and floods, oil/gas wells and pipelines, and transportation accidents. The county's mitigation strategies include:

- Page 8: fuel management and the use of wildfire-resistant materials.
- Page 8-9: burial of utility lines, where appropriate.
- Page 8-10: anchoring mobile homes and exterior structures, installing shelters.
- Page 8-11: elevating and dry-floodproofing flood-prone structures.
- Page 8-16: wetland restoration/protection.
- Page 8-19: pre-arrange or establish heating/cooling centers and shelters for vulnerable populations.
- Page 8-20: purchasing/distributing NOAA weather radios.
- Page 8-21: acquiring emergency power generators.
- Page 8-23: constructing shelters at key locations.
- Page 8-24: structural projects to increase water drainage, retention, and absorption capabilities.

ALGER COUNTY – Their plan was updated in December 2022. Hazards that were identified as posing the largest concerns included snowstorms, ice storms, extreme temperatures, severe winds, wildfires, infrastructure failures, public health emergencies, structural fires, and transportation accidents. This county receives an annual average snowfall of about 200 inches per year, which is also significant in its potential impact on major transportation routes for the Upper Peninsula (Highways 28, 67, 94, and US-41 pass through this county). Responders are concerned about visitor safety in ice caves near the Village of Chatham, and those on Grand Island. Wind hazards include a risk of seiche impacts in shoreline areas. Alger County's land area is 75% covered by forests, and 25% of the forests are coniferous, at greater risk of wildfires. Flooding has been an issue specifically along the Au Train River in Au Train Township, which has flooded due to sand shoaling from northwest winds and ice dams. Additional flood risk areas were identified in the Village of Chatham and the City of Munising. Infrastructure concerns include the potential freezing of water and sewer lines and an elevated water tank in Chatham. Hazard mitigation strategies include improvements in shelter and emergency power generator capacity, weather tower coverage, snow fences, defensible space in wildfire areas, building sprinkler systems, utility line burial/protection, water tank/line insulation, warning systems, and restoring or reconstructing a break wall at the Grand Marais Harbor. The county's hazard mitigation strategies include:

- Chapter 5, pages 2, 4, and 6 through 8: providing generators at municipal fuel pumping facilities, shelters, and water/wastewater treatment facilities.
- Chapter 5, page 3: improving weather tower coverage and the use of NOAA weather radio.
- Chapter 5, pages 3 and 6: create additional fire breaks in high-risk forest areas.
- Chapter 5, page 3: install snow fences or living snow fences at key roadway segments.
- Chapter 5, page 4: create defensible space around properties in high-risk forest areas.
- Chapter 5, page 5: installing and upgrading fire sprinkler systems in certain buildings.
- Chapter 5, page 5: bury and protect utility lines.
- Chapter 5, page 5: insulate water and sewer lines and storage tanks.
- Chapter 5, pages 5 and 6: maintain, improve, and expand emergency warning systems.

- Chapter 5, page 5: restore or reconstruct the break wall at the Grand Marais harbor.

ALLEGAN COUNTY – Their plan was updated in November 2021. Although hazard risks were not ranked against each other within the Allegan County hazard analysis, the county has reported significant flooding problems, shoreline erosion, dam failure risks, wildfires, pipeline and public health concerns, transportation accidents, sinkholes/subsidence, and severe weather risks of both the summer and winter variety. Severe weather hazards include tornadoes and severe winds, thunderstorms, severe cold, and droughts. The county is also faced with severe winter storms due to significant amounts of lake-effect snow from Lake Michigan. Allegan County has 7 dams that have significant/high risk potential for downstream developments. Infrastructure failure has also been identified as a hazard, and there is a significant risk of hazardous materials incidents, particularly along I-196, US-31 and US-131. Within the county, a plan for the Pokagon Band of Potawatomi was FEMA-approved in July 2012. The county's hazard mitigation strategies include:

- Page 98: City of Allegan to replace a warning siren, stabilize mill race near power plant, alleviate flooding/erosion in the area of Cedar/Cutler.
- Page 101: City of Fennville to install an emergency warning siren in its southeast sector.
- Page 102: City of Holland to reduce stormwater flooding, strengthen power line resilience, establish a city-wide warning system.
- Page 104-5, 107, 111, 113: City of Plainwell, Village of Hopkins, and Townships of Casco, Hopkins, Leighton flood mitigation.
- Page 106: Allegan Township wildfire mitigation through slash reduction, extended water lines, and widened roads.
- Page 108, 127: Allegan County and Cheshire Township to install new warning sirens.
- Page 109: Dorr Township seeks to install a tornado shelter.
- Page 109, 125: Allegan County and Fillmore Township seek to install an InformaCast mass notification system.
- Page 110: Ganges Township to reduce coastal erosion.
- Page 110: Gun Plain Township to reduce flood concerns, become Firewise, and expand warning sirens in its north.
- Page 112, 114-115: Townships of Laketown, Monterey to become Firewise, reduce flood losses.
- Page 112-3, 122: Allegan County, and the Townships of Lee, and Manlius seek to become Firewise.
- Page 115: Otsego Township to install dry hydrants and warning sirens.
- Page 118, 130: Allegan County and Saugatuck Township to protect roads from shoreline erosion.
- Page 119-120, 131: Watson Township and Allegan County seek to reduce dam failure risks.
- Page 120-122, 128: Allegan County to install Honeywell warning system, make roads more flood-resistant, provide backup power generators for shelters or relief centers.
- Page 126: Allegan County to study Western Michigan University plan to reduce the area's carbon footprint.
- Page 132: Allegan County to improve drainage infrastructure.

ALPENA COUNTY – Their plan was updated in January 2022. The plan gives top priority to infrastructure failures, shoreline hazards, public health emergencies, extreme temperatures, floods, ice storms and snowstorms, structural/industrial fires, and hazardous materials incidents. There are two dams with significant downstream developments that must remain protected. A specific location of flooding was identified at the Washington Bridge on US-23 where it crosses the Thunder Bay River. Various plans and studies are listed to inform specific hazard mitigation projects that could follow. The county's hazard mitigation strategies include:

- Page 8-2 to 8-18, 8-33 to 8-36: multiple plans/studies are listed that could become the first part of a two-phase mitigation activity.
- Page 8-23: create defensible spaces around vulnerable structures to reduce wildfire risks.
- Page 8-23: vegetation/fuel management to reduce wildfire risks.
- Page 8-24: coordinate to address contaminated sites.
- Page 8-24: coordinate to reduce flood damages and improve drainage.
- Page 8-34: develop an integrated water supply system.

ANTRIM COUNTY – Their plan was newly updated in October 2023. The county's top-priority hazards include public health emergencies, winter weather, hail, severe winds, tornadoes, floods, and lightning. Severe thunderstorms and high winds during the summer could affect the county's seasonally expanded population and associated area festivals. Specific locations of vulnerability include structures and roadways along Torch Lake, along US-31 through Elk Rapids, the Shanty Creek Resort area (with water and communication towers), and various shoreline erosion sites. The county's hazard mitigation strategies include:

- Page 104: new warning sirens in the Villages of Bellaire, Central Lake, Elk Rapids, and Ellsworth.
- Page 108-109: infrastructure improvements at 11 specific locations, to improve drainage and stream-flow.
- Page 109: maintenance of three specific dams.
- Page 109: investigate the relocation of structures and burial of utility lines.
- Page 110: separation of storm and sanitary sewers (5 locations listed).

- Page 110: backup generator installation (locations still to be determined).
- Page 110: install backflow prevention valves (4 villages listed).
- Page 110: replace two water control structures (Six Mile Lake and St. Clair Lake).

ARENAC COUNTY – In their updated plan that was approved in April 2023, infrastructure failures, transportation accidents, public health emergencies, floods, ice storms, snowstorms, lightning, extreme heat, severe winds, and drought were identified as the top hazards. The county's hazard mitigation strategies include:

- Page 246: the purchase and distribution of NOAA Weather Radios to residents, organizations, and businesses.
- Page 246: acquisition and use of emergency power generators at key community facilities.
- Page 248: installation of warning sirens.
- Page 248: installation of concrete safe rooms.
- Page 249: anchoring of manufactured homes and exterior structures.
- Page 250: install snow fences or living snow fences.
- Page 251: create defensible spaces against wildfires.

BARAGA COUNTY – This plan was updated and approved by FEMA in January 2022. The county's most significant hazards were identified as snowstorms, shoreline hazards, public health emergencies, invasive species, structural fires, wildfires, floods, severe winds, infrastructure failures, and pipeline accidents. Millions of dollars of damages were caused by three floods between 1994 and 2003, and the county also contains high-risk shoreline erosion areas along Lake Superior. If something causes US-41 between L'Anse and Baraga to close, it could cause a 5-mile trip between the two places to require travel of 100 miles along other roads, due to the lack of good surface-travel alternatives. The Baraga County plan proposes the creation of an alternative route between the two communities since the current highway is vulnerable to floods, erosion, transportation accidents, hazardous material spills, and severe winter weather. The county's hazard mitigation strategies include:

- Page 133: drainage system improvements.
- Page 134: bank stabilization activities along the Sturgeon River and Lake Superior shoreline.
- Page 135: retrofitting of underground utility pipes.
- Page 136: remediation of hazardous materials sites.
- Page 138: developing an alternative connecter route between US-41 and M-38.

BARRY COUNTY – In their June 2023 plan, top concerns included snow and ice storms, hazardous materials transportation accidents, terrorism, nuclear weapons, extreme temperatures, lightning, fixed site hazardous materials incidents, and tornadoes. This state plan had identified two local jurisdictions with significant development pressures. The local plan also refers to addresses with repetitive flood losses, but a huge cost that makes an acquisition project unfeasible. The county's hazard mitigation strategies include:

- Page 78: emergency warning systems and safe room installation for wind hazards.
- Page 78: drainage system improvements throughout the county, for flood hazards.
- Page 78: drip irrigation systems in five jurisdictions, for drought hazards.

BAY COUNTY – In their March 2022 plan, the top hazards included severe winds, hail, ice storms, snowstorms, lightning, shoreline hazards, hazardous materials incidents, and oil/gas pipelines and wells. The county plan lists numerous repetitive-loss properties and describes numerous flood events resulting in more than $100 million in damages. Winter storm damages have resulted in nearly $40 million in damages since 1967. The county's hazard mitigation strategies include:

- Page 139: improvements to drainage infrastructure throughout the county.
- Page 139: dike repair and pump replacement to improve water flow away from the airport.
- Page 140: acquire and clear selected repetitive-flood claim properties so that new green space can reduce floods.
- Page 141: separation of combined sewer systems to improve drainage capacity.
- Page 142: reinforce/update dikes to reduce shoreline hazards along Saginaw Bay.
- Page 143: purchase and install generators at selected critical facilities.
- Page 143: install retention and/or detention basins at strategic locations, to reduce floods.
- Page 144: elevate homes above the flood elevation level in floodplain areas.

BENZIE COUNTY – Their plan was updated in November 2023. Top hazards included public health emergencies, extreme cold, shoreline hazards, tornadoes, snowstorms, severe winds, floods, drought, hail, extreme heat, and lightning. The Platte, Betsie, and Herring River Basins are particularly prone to flooding, while the Lake Michigan coast is prone to erosion issues. The county experiences great seasonal population changes (up to 50% difference at one point in the year). The county's hazard mitigation strategies include:

- Page 104: flood mitigation activities involving FEMA grants: acquisition, relocation, elevation, floodproofing, or stormwater management.

- Page 104: prevent further bluff erosion in Crystal Lake Township.
- Page 106: foundation anchoring and mobile home tie-downs for wind mitigation and residential weatherization.
- Page 107: dam maintenance activities.
- Page 107-108: road/bridge improvements to prevent washouts, erosion, and floods.
- Page 109: install check-valves on stormwater discharge locations in the City of Frankfort.

BERRIEN COUNTY – This plan was updated and approved by FEMA in March 2023. The top county hazards include winter weather, extreme temperatures, severe winds, hail, and lightning, tornadoes, floods, and shoreline hazards. Annual average snowfall is 71 inches. The county proposed the use of generators for various critical facilities, the replacement of undersized culverts (at numerous specified locations), the relocation of the Berrien Springs Wastewater Treatment Plant, and the removal of two dams from along the Paw Paw River. The County includes nine communities identified in this state plan as being under significant development pressures. Within the county, a plan for the Pokagon Band of Potawatomi was FEMA-approved in July 2012. The county's hazard mitigation strategies include:

- Page 474: construct storm shelters where needed at public facilities.
- Page 474: purchase and install a backup power generator at county road commission headquarters.
- Page 475: install protective measures to limit bank erosion.
- Page 476-477: replace undersized culverts to reduce flooding.
- Page 480: install backflow prevention devices on fire hydrants.
- Page 481-482: install power generator at the water treatment plant and other selected locations.
- Page 483: install warning sirens at public beaches.
- Page 495: City of Buchanan flood mitigation and backup power generators.
- Page 498-499: City of St. Joseph flood mitigation, emergency generators, and storm shelter.
- Page 501: Berrien Township and Bertrand Township emergency generator installations.
- Page 502: Chikaming Township storm shelter installation.
- Page 502: Coloma Township sewer lift stations.
- Page 505: Niles Township warning siren installation.
- Page 512: Village of Shoreham bank stabilization and structure acquisition.

BRANCH COUNTY – The county's first official hazard mitigation plan was approved in July 2023. Tornadoes, severe winds, lightning, hail, floods, infrastructure failures, terrorism, nuclear power plant emergencies, and snow and ice storms were listed as the county's most significant hazards. Many townships don't have zoning ordinances, although the Coldwater area has experienced significant growth so far during the 21st Century. The county's hazard mitigation strategies include:

- Page 209: installation of warning sirens and systems.
- Page 209: anchoring of manufactured homes and exterior structures.
- Page 209: relocating or acquiring floodplain structures.
- Page 209: anchoring of manufactured homes and exterior structures.
- Page 210: installation of backup power generators.

CALHOUN COUNTY – Their plan was updated in September 2017. Top hazards include severe winds, floods, tornadoes, ice and snowstorms, hail, and lightning. The county's growth rate has slowed, and then reversed in the 21st Century, potentially relieving some development pressures while creating a new form of development need within a couple of the faster-shrinking communities. The county's hazard mitigation strategies include:

- Page 180, 181, 185, and 245: warning system upgrades.
- Page 180, 181, 185, and 246: backup generators.
- Page 180, 181, 185, and 246: elevation of structures.
- Page 180, 181, 185, and 247: safe room projects.
- Page 180, 181, 185, and 250: relocating vulnerable structures.
- Page 180, 181, 185, and 250: stormwater drainage system upgrade.
- Page 181 and 185: rainwater retention/detention project.
- Page 182: campus-wide building renovations.
- Page 182: roof rainwater runoff renovation.

CASS COUNTY – The top hazards in their March 2019 plan include severe winds, tornadoes, hail, lightning, ice storms and snowstorms, infrastructure failures, nuclear attack, cyberattack, and extreme temperatures. A nuclear plant in neighboring Berrien County also requires coordination activities to occur. The county contains two communities identified within this plan as experiencing significant development pressures. Within the county, a plan for the Pokagon Band of Potawatomi was approved by FEMA in July 2012. The county's hazard mitigation strategies include:

- Page 130, 132: early warning systems and emergency power generators.

- Page 131, 133: floodplain acquisition projects where appropriate.

CHARLEVOIX COUNTY – Charlevoix County is covered by the Charlevoix, Cheboygan, and Emmet County Regional Hazard Mitigation Plan, which was updated in October 2016. For Charlevoix County, the plan identified ice storms and snowstorms, severe winds, hail, lightning, wildfires, and tornadoes as the top hazards. Areas of particular concern are the area around the US-31 bridge in the City of Charlevoix regarding thunderstorms and high winds, the Boyne River and East Jordan area for flooding, the eastern portion of the county for potential wildfires and tornadoes, and wildfires in the rural areas of the county. Also, festivals frequently occur in seasonal population centers throughout the county. The county's hazard mitigation strategies include:

- Page 19, 122: dam management grant program to remove and/or maintain dams.
- Page 38-39, 77, 101, 104, 106-109, 115, and 117-121: improve warning system(s).
- Page 39: re-engineer culverts for flood mitigation.
- Page 82: government acquisition, relocation, or condemnation of structures within the floodplain.
- Page 104, 107, and 118: construct prearranged shelters.
- Page 106, 118: construct fire towers.
- Page 118, 121: retrofitting existing publicly owned facilities with generators.
- Page 123: improve and/or install water supply systems where possible for both structure fires and wildfires.

CHEBOYGAN COUNTY – Cheboygan County has an updated plan as of July 2023. Top hazards included ice storms, snowstorms, public health emergencies, infrastructure failures, wildfires, dam failures, transported hazardous materials, pipelines, severe winds, and floods. It is normal for this northern county to experience several heavy snow or ice events per year. The county's hazard mitigation strategies include:

- Page 127: improved warning systems.
- Page 128: arrangements for heating/cooling centers.
- Page 129: emergency power generators at key gasoline stations.
- Page 130: dam repair and maintenance.

CHIPPEWA COUNTY – Their plan was updated in August 2021. Top hazards included ice storms and snowstorms, wildfires, severe winds, public health emergencies, lightning, infrastructure failures, drought, and floods. The county's hazard mitigation strategies include:

- Page 91: emergency backup power generators at key facilities.
- Page 92-93: road, culvert, and bridge improvements for flood mitigation.

CLARE COUNTY – Their plan was updated in June 2023. Top hazards included invasive species, public health emergencies, severe winds and tornadoes, ice storms, snowstorms, hail, lightning, drought, and extreme temperatures. In 1977, 1400 acres were burned in a Summerville Township wildfire event. Clare also deals with substantial seasonal population increases (the 2010 census reported that 37% of their housing units were seasonal/recreational). The county's hazard mitigation strategies include:

- Page 124: expansion of the Tobacco Creek/Drain through downtown Clare.
- Page 124: acquisition and removal of appropriate structures from the floodplain area.
- Page 125: installing emergency power generators at municipal facilities.
- Page 125-126: replacing lead elements in the water supply system.
- Page 127: dam repairs and improvements (following a phase I study of specific dam risks).
- Page 128: Shamrock Dam replacement and spillway improvements.
- Page 128-130: sewer and water system improvements in the Cities of Harrison and Clare, and in Hayes Township.

CLINTON COUNTY – Top hazards include hail, lightning, severe winds, ice storms, snowstorms, tornadoes, drought, floods, dam failures, and extreme temperatures. Their updated plan was approved in August 2023. County planning for land use and capital improvements will reportedly be directed to incorporate hazard mitigation strategies into their plan updates. The county's hazard mitigation strategies include:

- Page 4-2: installation of snow fences or living snow fences to limit blowing and drifting snow.
- Page 4-3: installation of additional outdoor warning sirens.
- Page 4-10: install weather shelters at county parks and improve warning system capabilities in schools.

CRAWFORD COUNTY – Their plan was updated in January 2022. Top hazards include wildfires, hazardous materials facilities, structural fires, infrastructure failures, hazardous materials transportation, public health emergencies, severe winds, tornadoes, transportation accidents, and severe winter weather. The county's hazard mitigation strategies include:

- Page 8-8, 8-10: anchoring of mobile homes and provision of storm shelters at mobile home parks.
- Page 8-10: placement of snow fences or living snow fences along roadways with identified problem areas.

- Page 8-11: burial of utility lines, where feasible and cost-effective.
- Page 8-16: wildfire fuel management techniques.
- Page 8-18: maintain and improve the areaôs warning systems.
- Page 8-23: insulation of vulnerable portions of area water systems.

DELTA COUNTY ï Their plan was updated in February 2023. Top hazards included hazardous materials transportation incidents, ice storms, snowstorms, severe winds, lightning, hazardous materials sites, terrorism, tornadoes, public health emergencies, and wildfires. Four ice/sleet events were reported between 1996 and March 2017. Particular areas of concern include Ensign Township regarding wildland fires on the Stonington Peninsula, Ford River Township regarding ice jams on rivers, and Garden Township regarding flooding and ensuring that floodwaters are diverted into Lake Michigan. The countyôs hazard mitigation strategies were to:

- Page 5-3, 5-15: install an emergency warning system with different sounds for different event types, explore Reverse 9-1-1 calling system and smartphone-based warning applications.
- Page 5-5: purchase and distribute NOAA weather radios.
- Page 5-6: protection/burial of utility lines, as appropriate.
- Page 5-7: use snow fences or living snow fences at critical roadway segments.
- Page 5-7: expand shelter capabilities, including power generators.
- Page 5-9, 5-10: use of emergency power generators at critical facilities, schools, and the county airport.
- Page 5-9: use of check valves, sump pumps, and backflow preventers in homes and buildings.

DICKINSON COUNTY ï Their plan was updated in July 2018. Top hazards included tornadoes, public health emergencies, hazardous materials transportation incidents, earthquakes, transportation accidents, snowstorms, structural fires, hazardous materials sites, terrorism, and lightning, with earthquakes being combined with the effects of subsidence related to underground mining. Between 1996 and April 2017, 8 tornadic events occurred, with property and crop damage exceeding $7 million. The countyôs hazard mitigation strategies include:

- Page 153: use of emergency power generators at critical facilities.
- Page 153: filling or buttressing abandoned mines to discourage their collapse, especially in Iron Mountain, Norway, and Vulcan.
- Page 153-154: expand emergency warning systems and weather shelter locations across the county.
- Page 154: address the vulnerabilities of the repetitive-loss property identified in the City of Kingston, in coordination with its owner.

EATON COUNTY ï Their updated plan was approved in April 2023. Top hazards include hail, lightning, severe winds, ice storms, snowstorms, tornadoes, floods, drought, extreme heat, and dam failure. Recommendations are in-place for hazard mitigation considerations to inform comprehensive planning processes in the county (which has a county planning office). Their regional plan also includes Delta Township, which has its own distinct emergency management program. The countyôs hazard mitigation strategies include:

- Page 4-1: install a newer alert system in Delta Township.
- Page 4-3: replace and existing sandbag wall with a more permanent flood mitigation option around the City of Eaton Rapids.
- Page 4-4: inventory critical facilities and infrastructure that are at risk from flooding and to implement appropriate flood mitigation measures.
- Page 4-10: combine two drains (the Bank and Briggs) to expand drainage capacity in Delta Township and Eaton County.
- Page 4-10: relocate the Delta Township water resource recovery utility functions out of the floodplain by constructing a new facility in phases.
- Page 4-12: install electronic surge protection, emergency backup power at critical facilities, and retrofitting of critical structures to improve weather hazard resilience.

EMMET COUNTY ï The County is covered by the Charlevoix, Cheboygan, and Emmet County Regional Hazard Mitigation Plan, which was updated in October 2016. Top hazards include fires (structural and wildfires), severe winter weather, severe winds, tornadoes, hail, lightning, flooding (particularly in Harbor Springs, Boyer Creek, Tannery Creek, at the Alanson Locks and on the Bear and Maple Rivers), and shoreline and steep slope erosion (particularly on Lake Michigan and Little Traverse Bay). The countyôs hazard mitigation strategies include:

- Page 19, 122: dam management grant program to remove and/or maintain dams.
- Page 38-39, 77, 101, 104, 106-109, 115, and 117-121: improve warning system(s).
- Page 39: re-engineer culverts for flood mitigation.
- Page 82: government acquisition, relocation, or condemnation of structures within the floodplain.
- Page 104, 107, 118: construct prearranged shelters.
- Page 106, 118: construct fire towers.

- Page 118, 121: retrofitting existing publicly owned facilities with generators.
- Page 122: improve existing storm systems at US-31 near M-119 and in the Bayview area and at Cross Village, near the commercial district and at the Catholic church.
- Page 123: improve and/or install water supply systems where possible for both structure fires and wildfires.

GENESEE COUNTY – Their plan was updated in May 2022. Top county hazards involve infrastructure failures, floods, terrorism, structural fires, severe winds, hail, lightning, extreme temperatures, and hazardous materials transportation accidents. The county is prone to tornado occurrences and impacts, including its experience of the most destructive tornado in Michigan history (in 1953). Redevelopment pressures exist in jurisdictions throughout the county, with many municipalities experiencing significant population growth or decline. For example, the City of Flint lost 18% of its population between 2000 and 2010 and then 21% between 2010 and 2020. The county reports many identified repetitive-loss properties. A separate plan for the University of Michigan was also updated (including the Flint campus) in October 2019. The county's hazard mitigation strategies include:

- Page 149, 151-153, 156-159: install emergency power generators and weather shelters.
- Page 149, 157: river flood control measures.
- Page 151-155, 157-159: enhance warning siren systems.
- Page 151: provision of NOAA weather radios.
- Page 154, 159: assessment and repair of critical dams.

GLADWIN COUNTY – Their plan was updated in September 2016. Their top hazards were identified as severe winter weather, severe summer weather, infrastructure failures, floods, structural fires, wildfires, and public health emergencies. Dam failures, with six dams located upstream from developed parcels, are also a concern, particularly in Sherman Township. Severe weather is of concern in Clement Township, Gladwin Township, Hay Township, Secord Township, and Sherman Township. Infrastructure failures is an area of concern for Grout Township and Sage Township. The most significant hazards in Secord Township are structural fires and changes in its population. Strategies include:

- Page 116-117: expand the county hazard warning siren system.
- Page 117: install backup power generators at critical facilities, including battery backup packs.
- Page 100, 115, 120: designate township halls, Knights of Columbus halls, or new buildings as shelters, including generators.
- Page 118: purchase and provide NOAA weather radios for critical facilities.
- Page 123: after a wildfire vulnerability study, retrofit at-risk structures with ignition resistant materials.

GOGEBIC COUNTY – This plan was updated in June 2021. Top hazards include floods, snowstorms, invasive species, extreme temperatures, public health emergencies, severe winds, shoreline hazards, structural fires, and transportation accidents. The Ottawa National Forest makes up 80% of the county, with residential and commercial developments along a corridor between Wakefield and Ironwood. Residential development also occurs alongside numerous lakes, including Lake Superior. The City of Wakefield had produced a flood mitigation plan of its own (now expired), which had described needed improvements with a floodgate at an identified Sunday Lake problem area. Provisions for incorporating hazard mitigation into upcoming comprehensive plan updates should be in place. The county's hazard mitigation strategies include:

- Page 136: infrastructure improvements, including culverts, dams, and roads.
- Page 139: provide NOAA weather radios in schools and government buildings.
- Page 139-140: capping mineshafts.
- Page 140-141: drainage system improvements.

GRAND TRAVERSE COUNTY – Their plan was updated in September 2022. Top hazards facing the county included floods, severe winds, ice storms, snowstorms, wildfires, and shoreline hazards. Hazards threaten public infrastructure, including culverts, dams, and bridges concentrated throughout the Broadman River communities (Blair, East Bay, Garfield, Paradise, and Union Townships, and Traverse City). The county plan included part of the Grand Traverse Reservation area, as well. The county's hazard mitigation strategies include:

- Page 56: various flood mitigation activities involving infrastructure and replacing the Union Street Dam.
- Page 57: burial of utility lines where appropriate to protect them from weather hazards.
- Page 57: installation of emergency power generators.
- Page 58: shoreline drainage control projects in Traverse City and the townships of Acme, East Bay, and Peninsula.

GRATIOT COUNTY – Their plan was updated in July 2020. Their top hazards included energy emergencies, infrastructure failures, cyberattacks, structural fires, transportation accidents, public health emergencies, floods, extreme temperatures, and hazardous materials incidents. The county has incorporated hazard mitigation considerations into its master planning process. The county's hazard mitigation strategies include:

- Page 132: warning system improvements throughout the county.

- Page 132: improvements to drainage infrastructure to reduce floods.
- Page 132: bridge and culvert work to reduce floodway obstructions.
- Page 133: install USGS stream gauge at the Pine River in Alma.
- Page 134: separation of sanitary and storm sewers in municipal areas.
- Page 134-135: installation of lightning protection devices at municipal facilities and schools.
- Page 136: expand the number of public shelters in the county.
- Page 137: acquire and install emergency power generators at critical infrastructure locations.

HILLSDALE COUNTY – A plan was completed and then approved by FEMA in September 2012. Their top hazards included energy emergencies, snowstorms, ice storms, tornadoes, structural fires, wildfires, oil/gas well accidents, public health emergencies, lightning, and infrastructure failures. Local development trends focus new developments (of all kinds) around existing cities, villages, selected unincorporated settlements along major roadways, and around ponds and lakes. The county's hazard mitigation strategies include:

- Page 45-46: enhance flood insurance related information about at-risk structures in flood zones.
- Page 124: separation and/or expansion of sewer systems to handle anticipated stormwater volumes.
- Page 124: use of generators for backup power at critical facilities and school buildings.
- Page 125: install early warning siren systems where warranted.
- Page 128: provide back-up generators for water and wastewater treatment facilities.

HOUGHTON COUNTY – Their plan was updated in June 2020. The top hazards include public health emergencies, snowstorms, floods, infrastructure failures, invasive species, structural fires, shoreline hazards, extreme temperatures, and transportation accidents. In April 2001, a 3-foot sinkhole appeared near the corner of Red Jackal Road and US-41 in Calumet. The mining inspector reports that numerous ground subsidence events occur each year. Less than half of the county's jurisdictions are zoned, but a consideration of hazard mitigation in future planning is encouraged in the local hazard mitigation plan. A separate plan for Michigan Technological University was completed and approved in March 2020. The county's hazard mitigation strategies include:

- Page 151-152: Sturgeon River bank stabilization in Chassell Township.
- Page 152: stormwater drainage upgrades for flood mitigation.
- Page 152-153: installation of green infrastructure.
- Page 153: improvements to road culvert infrastructure.
- Page 154: cap old mine shafts and stabilize slopes.
- Page 155: retrofit and insulate water system pipes.
- Page 156: adjust bridge approaches on the Portage Canal to accommodate potential temporary or portable bridge arrangements should something happen to the main bridge.
- Page 158: improve weather shelter capacity.
- Page 159: dam improvements to reduce risks of failure.

HURON COUNTY – Their plan was updated in March 2022. Top hazards include floods, severe winds, hail, lightning, structural fires, ice storms, snowstorms, transportation accidents, and extreme temperatures. New developments tend to occur near existing cities and villages, and along the coastline of Saginaw Bay and Lake Huron, where future condominium developments are anticipated. The incorporation of hazard mitigation considerations into other plans is noted in the county hazard mitigation plan. The county's hazard mitigation strategies include:

- Page 128, 134: bridge replacements to improve water flows below.
- Page 128, 135: culvert/drain improvements and replacements.
- Page 128, 130, 135: improve Sebewaing Levee System, in conjunction with USACE.
- Page 130, 138: improve emergency notification systems.
- Page 130, 139: expand/improve break walls and drains at shoreline harbor areas, especially the City of Caseville.
- Page 130, 139: raising dock and marina infrastructure levels to reduce flooding in the City of Harbor Beach.

INGHAM COUNTY – Their plan was updated in August 2023. Top hazards include hail, lightning, severe winds, ice storms, snowstorms, drought, floods, tornadoes, dam failures, and extreme temperatures. Within the county, Michigan State University has also developed its own hazard mitigation plan, first approved in November 2016, and achieved EMAP accreditation. The City of Lansing completed its own plan update in January 2019. The county's hazard mitigation strategies include:

- Page 4-1: installation of backflow prevention devices in the City of East Lansing.
- Page 4-2: inventory properties with flood vulnerabilities and implement appropriate flood mitigation.
- Page 4-2: upgrade and expand the county's outdoor warning siren network.
- Page 4-4: Meridian Township will utilize the Land Preservation Acquisition Fund to preserve environmentally sensitive lands.

- Page 4-10: retrofit critical structures to improve their weather hazard resilience.
- Page 4-10: hire an engineer to analyze alternatives and implement one to prevent failure of the Lake Lansing Dam.
- Page 4-13: install electronic surge protection and backup power for critical facilities.
- Page 4-21: install additional outdoor warning sirens in the southwest portion of Delhi Township.

IONIA COUNTY – Their unfinished draft plan identified risks from flooding, hail, severe winds, ice storms, tornadoes, snowstorms, lightning, drought, wildfires, and extreme temperatures. The Grand River, other rivers, streams, and inland lakes have had floods associated with them. Electrical and phone services have been interrupted by summer storms and associated winds and hail. From 1950 to 2004, 172 significant weather events affected the county, resulting in three deaths, 17 injuries, and about $20 million in property damage. The draft plan's pages were not numbered, but the county's proposed hazard mitigation strategies include:

- Acquiring portable generators to provide back-up power for water and wastewater treatment facilities.
- Identifying flood-prone structures and implementing flood mitigation actions for them.
- Constructing dikes at the Ionia County Jail.

IOSCO COUNTY – Their plan was updated in September 2016. Although not prioritized in the plan, their identified hazards include severe weather, geological threats, fires, flooding, drought, hazardous materials incidents, infrastructure problems, public health emergencies, transportation incidents, seasonal population shifts, civil unrest, and war. The shoreline area may be the most vulnerable part of the county and has had greater interest from developers. The county's hazard mitigation strategies include:

- Page 130: expand siren warning systems.
- Page 131: acquire emergency power generators (especially for critical facilities).
- Page 132: purchase NOAA weather radios.
- Page 132: obtain cell-phone-based warning system such as CodeRED.
- Page 135: install living snow fences along major county roads.

IRON COUNTY – This plan was updated and approved by FEMA in November 2022. Top hazards include invasive species, snowstorms, extreme temperatures, public health emergencies, structural fires, wildfires, transportation accidents, severe winds, floods, and subsidence. There are areas of the county that contain no zoning, but a consideration of hazard mitigation is encouraged for future master planning activities. The county's hazard mitigation strategies include:

- Page 139: capping/fencing mine shaft openings and reduce hazardous mine-related slopes.
- Page 140-141: retrofit and insulate underground water, wastewater, sewer pipes to prevent freeze damage and other degradation.
- Page 141: analyze dam risks and implement appropriate flood mitigation activities.

ISABELLA COUNTY – Their plan was updated in January 2023. Top hazards include infrastructure failures, ice storms, snowstorms, extreme cold, severe winds, hail, lightning, public health emergencies, and terrorism. Areas of the county have notable development pressures, such as the city Mt. Pleasant and the area around Soaring Eagle Casino. Local communities in the county are encouraged by its hazard mitigation plan to incorporate hazard mitigation into their comprehensive planning activities. The county's hazard mitigation strategies include:

- Page 124: maintenance of and improvements to the county's mass notification warning systems.
- Page 125: Chippewa River erosion control measures.
- Page 125, 129: installation of river gauges, markers, and flow meters in coordination with the Saginaw Chippewa Tribe.
- Page 127-128: replacement of NOAA weather radios where needed at schools, government buildings, etc.
- Page 128: install living snow fences along U.S. 127 between the Village of Shepherd and the City of Mt. Pleasant.
- Page 128: improvements to the Upton Drain system and stormwater management there.
- Page 132-133: installation of lightning protection devices.
- Page 133-136: storm sewer improvements at multiple specific locations in the City of Mt. Pleasant.
- Page 136-137: install rip-rap, backup power generators, and backup water wells for the City of Mt. Pleasant.

JACKSON COUNTY – A plan was completed and then approved by FEMA in October 2022. The top hazards in the county include public health emergencies, snowstorms, ice storms, energy emergencies, infrastructure failures, transportation accidents, terrorism, pipelines, severe winds, and extreme temperatures. The final edition of the plan also identified civil disturbances as an additional high priority. Various communities have significant development pressures within the county (6 identified within this state plan). The county's hazard mitigation strategies include:

- Page 77: increase the use of NOAA weather radios, and install emergency power generators at critical facilities.
- Page 78: separation of combined sewer systems.
- Page 79: burial of utility lines, where appropriate.

- Page 79, 81: installing snow fences or living snow fences.
- Page 81-82: using laminated glass and other resilient construction materials in public buildings and critical facilities.
- Page 82: use of electronic surge protectors and lightning protection devices.
- Page 83: anchoring of manufactured homes and exterior structures.
- Page 84: use of wind engineering measures and installation of safe rooms in homes, shelters, mobile home parks, fairgrounds, etc.
- Page 84-85: install emergency power generators and warning sirens at various specific locations throughout the county.
- Page 85: flood mitigation project at a specific location in Parma and Rives Townships and the Village of Parma.
- Page 86: dam resilience measures in the Village of Concord, and dam removal in the Village of Brooklyn.

KALAMAZOO COUNTY – This plan was updated and approved by FEMA in July 2023. Top hazards include extreme cold, hail, lightning, snowstorms, severe winds, floods, extreme heat, tornadoes, ice storms, and wildfires. There are numerous areas of strong development pressures within the county (nine identified within this state plan), and the incorporation of hazard mitigation considerations into master planning has been promoted, with multiple local participants agreeing in principle to do so in their plan updates. The county's hazard mitigation strategies include:

- Page 5-1: add new warning systems and sirens where gaps exist.
- Page 5-2 and 5-4: add safe rooms for weather sheltering.
- Page 5-2: anchoring of mobile homes.
- Page 5-4: provide weather shelters and install snow fences or living snow fences for winter weather mitigation.
- Page 5-5: install backup power generators at key facilities.
- Annex A: Portage Creek flood control project.
- Annex B: northside Kalamazoo stormwater relief project.
- Annex C: water and wastewater generator project.

KALKASKA COUNTY – Their plan had an updated draft completed in October 2023. Top hazards included public health emergencies, tornadoes, severe winds, ice storms, snowstorms, wildfires, lightning, and floods. The county's hazard mitigation strategies include:

- Page 71, 77: improvement of warning systems.
- Page 72, 78: maintain/expand shelter locations.
- Page 79: Youngs Dam maintenance/repairs in Boardman Township.
- Page 79: several specific flood mitigation activities using FEMA funds.

KENT COUNTY – Their plan, a combined regional plan with Kent County and the City of Grand Rapids, was updated and approved by FEMA in May 2023. Top hazards included public health emergencies, floods, shoreline hazards, infrastructure failures, pipeline incidents, hail, severe winds, lightning, energy emergencies, and extreme temperatures. Most of the county is under strong development pressure. A list of repetitive loss properties was included in the local hazard mitigation plan. The county's hazard mitigation strategies include:

- Page 161, 664, 667, 670-671, 724: improvement of warning systems.
- Page 164, 684, 722, 758: backup systems and emergency power generators at critical infrastructure.
- Page 165-166, 665, 673-674, 677, 681-682: structural and environmental flood control measures.
- Page 167: provision of green space for heat and flood reduction.
- Page 668-669, 671: infrastructure improvements.
- Page 716-718: specific multi-hazard activities for the City of Kentwood.
- Page 729: acquisition of flood-prone properties, as feasible, in Plainfield Township.
- Page 751-754: specific multi-hazard activities for the City of Walker.

KEWEENAW COUNTY – This plan was updated and approved by FEMA in August 2022. Top hazards include public health emergencies, snowstorms, floods, infrastructure failures, structural fires, invasive species, extreme temperatures, shoreline hazards, and transportation accidents. This is the least populated county in Michigan, and although residential growth trends were evident for a period of time they have since calmed (according to census data). The county's hazard mitigation strategies include:

- Page 134: erosion stabilization project in Grand and Sherman Townships.
- Page 135: mitigation of flooding and dam vulnerabilities in Eagle Harbor Township.
- Page 136: address mine shaft and slope safety with capping and supports.
- Page 137: structurally bolster the historic Copper Falls tower in Eagle Harbor Township.
- Page 138: Grant Township sewage system improvements.
- Page 138-139: drainage system improvements in the county.

LAKE COUNTY – An updated draft of their plan was received in November 2023. Top hazards include ice storms, snowstorms, severe winds, floods, wildfires, infrastructure failures, extreme temperatures, structural fires, and public health emergencies. The county had various areas of significant development pressures, with residential developments concentrating near the villages of Baldwin and Luther, and around various lakes in the county. The plan notes the presence of two repetitive-loss properties. The county's hazard mitigation strategies include:

- Page 140: FEMA-fundable flood mitigation activities.
- Page 141: water retention areas and wetland restoration.
- Page 141: floodproofing measures.
- Page 141: lightning protection at key infrastructure and facilities.
- Page 141, 143: burial of utility lines, where feasible.
- Page 141: anchoring of manufactured homes.
- Page 143: use of back-up power generators at key facilities.

LAPEER COUNTY – Their plan was updated in April 2022. Top hazards included ice storms, snowstorms, structural fires, floods, infrastructure failures, tornadoes, hail, severe winds, lightning, and public health emergencies. The county had patterns of significant growth and associated development pressures, including the appearance of ten mobile home parks within several years. All participating local jurisdictions (27 of them) agreed to consider hazard mitigation concerns within their other planning activities. An estimated 615 structures were located within floodplains. A restoration project of the Bell River in Imlay City was reportedly ongoing. The county's hazard mitigation strategies include:

- Page 136, 138, 142, 144-146: enhance emergency warning systems.
- Page 136-139, 142-144, 146: install emergency power generators.
- Page 137-139, 144, 146: increase community weather/storm shelter provisions.
- Page 137, 140, 144-146: infrastructure improvements.
- Page 137, 144-146: flood mitigation activities.
- Page 140, 144: dam repair and improvements.
- Page 144-146: local community detail of multi-hazard mitigation projects.

LEELANAU COUNTY – Their plan was updated in August 2023. Top hazards included public health emergencies, ice storms, snowstorms, severe winds, hail, shoreline hazards, extreme temperatures, floods, and lightning. The southern half of the county's coastline is considered a high-risk erosion area. The county plan included part of the Grand Traverse Reservation area, as well. The county's hazard mitigation strategies include:

- Page 100: expand warning siren coverage in the county.
- Page 101: FEMA-fundable flood mitigation activities.
- Page 102: expand weather/storm shelter capacities in the county, including emergency power generators.
- Page 103: install an emergency generator for one of the two main water wells in the Village of Empire.
- Page 103: infrastructure improvements, including separation of sanitary and storm sewer systems.
- Page 104: dam maintenance at major dams, and upgrades for the Leland Dam.
- Page 104: where appropriate, burial of utility lines.

LENAWEE COUNTY – A plan was completed and then approved by FEMA in August 2023. Top hazards included energy emergencies, hazardous materials incidents, infrastructure failures, public health emergencies, structural fires, cyberattacks, wildfires, ice storms, and snowstorms. Significant development pressures exist in some areas of the county. The county's hazard mitigation strategies include:

- Page 127: implement flood mitigation activities identified from an initial research phase.
- Page 128: improvements to county waterway systems.
- Page 130: installation of dry hydrants.
- Page 131: install living snow fences at identified roadway areas.
- Page 131: building retrofits with sprinkler systems.
- Page 132: improvements to emergency warning systems.
- Page 133: installation of emergency power generators at key facilities.
- Page 134: dam repair and upgrade activities.
- Page 137: separation of combined sewer systems, other expansion of sewer system infrastructure.

LIVINGSTON COUNTY – Their plan was updated in April 2022. Top hazards included severe winds, tornadoes, snowstorms, wildfires, ice storms, floods, dam failures, extreme temperatures, and drought. The county is one of the most rapidly growing in the state, with numerous areas of strong development pressures throughout it. The county is very proactive in promoting the inclusion of hazard mitigation considerations within master planning, having identified the potential for development to cause increased risks from flooding. The county's hazard mitigation strategies include:

- Page 174, 183: acquisition of up to 25 flood-prone properties in Green Oak Township, subject to owner coordination.

- Page 179: improve the distribution of storm/weather shelter facilities throughout the county.
- Page 184: maintain and increase the use of stream gauges in county water courses.

LUCE COUNTY – Their plan was updated in August 2021. Top hazards included ice storms, snowstorms, public health emergencies, severe winds, hail, lightning, wildfires, extreme temperatures, and infrastructure failures. The county is mostly rural, forested land, with various locations of development (of different types) noted in the local hazard mitigation plan. Encouragement is provided for the consideration of hazard mitigation topics within the county master plan. (The county has its own planning office.) The county's hazard mitigation strategies include:
- Page 82: install emergency power generators in specified local community facilities.
- Page 84: improvements to water and sewer infrastructure.

MACKINAC COUNTY – Their plan was updated in March 2022. Their top hazards are ice storms, snowstorms, public health emergencies, severe winds, hail, lightning, extreme temperatures, infrastructure failures, and wildfires. The integration of hazard mitigation into local comprehensive planning is encouraged. The county's hazard mitigation strategies include:
- Page 76: installation of emergency power generators at specific local sites.
- Page 76-77: shoreline/road stabilization at a specific location for erosion mitigation.
- Page 77: specific drainage infrastructure improvement project in the City of St. Ignace.
- Page 77: structural stabilization of Wawatam Lighthouse Dock Pier in the City of St. Ignace (erosion mitigation).
- Page 77: drainage improvements in Clark Township for flood mitigation.
- Page 77-78: purchase/equip portable generator trailer for countywide emergency use.

MACOMB COUNTY – This plan was successfully updated before the 5-year schedule established by federal regulations, in April 2021, and each update has usually been completed in advance of the plan's expiration date. Although the plan did not rank its hazards, significant ones include tornadoes, severe winds, winter weather (extreme cold and ice/sleet/snowstorms), transportation hazardous materials incidents, and flooding (which received great emphasis in the plan). The county is under very strong development pressures, especially in its northern, less-developed half. Encouragement of hazard mitigation considerations in comprehensive planning is given within the plan. The county's hazard mitigation strategies include:
- Page 104-158: extensive and detailed description of flood vulnerabilities by local community.
- Page 165, 169, 172-187, 190, 192-194, 196-197, 203, 208-211, 213-216, 224, 228, 233-234, 236-238: specific flood mitigation activities.
- Page 166, 172, 189, 191, 195, 202, 205, 208, 211, 216-218, 220-221, 223, 227, 232, 235: emergency backup power generator installations at specific locations.
- Page 166, 168, 189, 197, 214, 219, 222, 227, 231-232, 240: improvements in warning siren/notification coverage in specific communities.
- Page 167, 202, 204, 212, 216, 222, 228, 239: install storm/weather shelters in specific communities.
- Page 168: specific bridge repair project.
- Page 170, 199: sanitary sewer overflow projects.
- Page 171, 217, 229: underground utility lines, where feasible.
- Page 199-200, 205-208, 221, 224-226, 230, 239: infrastructure improvements.
- Page 201: construction of seawall.

MANISTEE COUNTY – Their plan was updated in July 2015. Top hazards include floods and dam failures, wildfires, ice storms, snowstorms, extreme cold, and shoreline hazards. Numerous historic events have been documented in the plan for each of these hazards (except dam failures). The county's hazard mitigation strategies include:
- Page 30: acquisition of properties in floodplain areas.
- Page 21, 22, 25: concern over dam failures at Tippy and Hodenpyl that would cause bridge damage.

MARQUETTE COUNTY – Their plan was updated in January 2021. Top hazards included infrastructure failures, public health emergencies, snowstorms, severe winds, extreme temperatures, wildfires, structural fires, transportation accidents, and hazardous materials sites. This county's local jurisdictions experience some development pressures, with a few areas seeing significant new development. Developments in the Chocolay and Carp River drainage basins are increasing the amount and rate of run-off, exacerbating problems for older developments downstream. Hazard mitigation considerations are recommended in local comprehensive planning activities. Flood damages were noted for 475 parcels, with ten parcels experiencing multiple damages. Originally developed to satisfy both FMA and HMGP standards, the county's hazard mitigation plan includes a flood mitigation emphasis within it. The county's hazard mitigation strategies include:
- Page 94: implementation of items from their Wildfire Protection Plan.
- Page 95: provision of weather shelters for vulnerable populations.

- Page 95: improvement of firefighting water supply and installation of dry hydrants.
- Page 96-99: various specific local multi-hazard mitigation strategies.

MASON COUNTY – Their plan was updated in November 2023. Top hazards include ice storms, snowstorms, severe winds, wildfires, shoreline hazards, extreme temperatures, public health emergencies, invasive species, and structural fires. The county's hazard mitigation strategies include:
- Page 165: protection/restoration of wetlands and natural water retention areas.
- Page 165-166: general use of FEMA funds for multi-hazard mitigation activities.
- Page 166: provide additional NOAA weather radios.
- Page 167: installing backup generators at key facilities.
- Page 168: protect infrastructure function through erosion control, stormwater management, and living snow fences.

MECOSTA COUNTY – Top hazards within their 2001 hazard analysis appeared to include ice storms, snowstorms, structural fires, severe winds, wildfires, hazardous materials, transportation accidents, floods, hail, tornadoes, and pipelines. The county had not completed a FEMA-approvable hazard mitigation plan containing specific strategies.

MENOMINEE COUNTY – Their plan was updated in March 2023. Top hazards include ice storms, snowstorms, severe winds, extreme temperatures, transportation accidents, lightning, structural fires, hazardous materials transportation accidents, and cyberattack. The county's plan also identified 80 structures within Spalding Township as being at risk for potential flooding. High-risk shoreline erosion areas were also noted along the Green Bay shoreline. Various areas of development were noted in the plan but were not necessarily indicative of exceptional development pressures. The county's hazard mitigation strategies include:
- Page 5-3: install lightning protection devices on key infrastructure.
- Page 5-4: install snow fences or living snow fences on critical roadway segments.
- Page 5-4: purchase NOAA weather radios for use at local schools.
- Page 5-5, 5-10, 5-13, 5-15: expand emergency warning systems within county communities.
- Page 5-7: install check valves, sump pumps, or backflow preventers in homes and buildings.
- Page 5-8: burial of utility lines, where appropriate.
- Page 5-8, 5-9: provide emergency power generators at key fuel pumping facilities and critical infrastructure.
- Page 5-8: expand weather/storm shelter capacity in the county.
- Page 5-14: improve drainage capacity and infrastructure.

MIDLAND COUNTY – This plan was updated and approved by FEMA in January 2019, and the county's top hazards included severe winds, ice storms, snowstorms, floods, dam failures, tornadoes, public health emergencies, wildfires, infrastructure failures, and terrorism. The presence of development on the Tittabawassee River, downstream from two dams, was noted. Development trends were noted in the City of Midland and along M-20 between Midland and the western county line. Development was considered likely to increase in that area west of Midland and along M-30 north of the Village of Sanford. The county amended its plan to meet requirements for the HHPD Grant Program. The county's hazard mitigation strategies include:
- Page 91: add stream gauges for monitoring river flows.
- Page 94: expand warning siren/system coverage.
- Page 95: provide NOAA weather radios to selected facilities.
- Page 99: flood mitigation activities.
- Page 100: installation of sump pumps and backflow preventers.

MISSAUKEE COUNTY – Their plan was updated in June 2023. Top hazards include public health emergencies, severe winds, hail, tornadoes, ice storms, snowstorms, lightning, wildfires, and extreme temperatures. Most of the county is either forest or wetlands, and development pressures appear very limited. The county's hazard mitigation strategies include:
- Page 74: installation of a new warning siren in Lake City.
- Page 78: general FEMA-fundable flood mitigation activities.
- Page 78: change lake level control structures at Missaukee Lake.
- Page 78-79: specific drainage infrastructure improvements.

MONROE COUNTY – Their plan was updated in July 2017. Top hazards include tornadoes, floods, transportation accidents, hazardous materials incidents, infrastructure failures, severe winds, ice storms, shoreline hazards, and public health emergencies. The county also has a nuclear power plant that is well-monitored and prepared through regular exercises, protocols, and warning systems. The county contains numerous areas with strong development pressures. Within the county, the Estral Beach had its own distinct hazard mitigation plan, which had been approved in June 2015 and whose main elements were included in the county's plan. The county's hazard mitigation strategies include:

- Page 166-167, 172: provide more safe rooms and warning systems in the county.
- Page 168, 178-179, 184, 193, 198, 203: flood mitigation activities for repetitive-loss properties and other identified at-risk structures.
- Page 173-174, 179, 182, 184, 187-189, 191-192: acquire emergency power generators for selected locations.
- Page 179: dike resilience for Estral Beach in coordination with USACE.
- Page 182: seawall restoration project in Frenchtown Township.
- Page 188: address erosion in Milan.
- Page 190-191: footing drain disconnection program in Monroe.

MONTCALM COUNTY – Their plan passed FEMA review in mid-2023 and requires local adoption in order to receive full approval. The county's top hazards included severe winds, floods, hail, ice storms, tornadoes, extreme cold, snowstorms, lightning, wildfires, and extreme heat. The county hazard mitigation plan described numerous township areas experiencing significant development pressures. The county's hazard mitigation strategies include:
- Page 114-115: improved emergency alert notification systems.
- Page 115: increase weather/storm shelter capacity within the county.
- Page 117-118: flood mitigation activities.
- Page 118: provision of emergency power generators at selected facilities.

MONTMORENCY COUNTY – Their plan was updated in February 2022. Top hazards include wildfires, public health emergencies, severe winds, ice storms, snowstorms, structural fires, infrastructure failures, transportation accidents, transported hazardous materials, and hail. The county's hazard mitigation strategies include:
- Page 8-9: create defensible space around wildfire-vulnerable structures.
- Page 8-10: improve water and sewer system resilience, including insulation and future upgrades.
- Page 8-10: anchoring of mobile homes and exterior structures.
- Page 8-17: provide emergency power generators at critical facilities.
- Page 8-18: expand weather/storm shelter capacity within the county.
- Page 8-20: enhance emergency warning system capacity in the county.
- Page 8-23: installation of snow fences or living snow fences.

MUSKEGON COUNTY – Their plan was updated in October 2015. Top hazards included ice storms, snowstorms, severe winds, structural fires, infrastructure failures, extreme temperatures, floods, droughts, and shoreline hazards. The county plan recommends "smart growth" to direct new developments and reported that numerous parts of the county experienced strong development pressures. Mitigation actions include the consideration of hazard mitigation in comprehensive plans, assessing the capacity of current urban storm sewer systems, and the use of snow fences along roadways. The county's hazard mitigation strategies include:
- Page 146: raise or relocate buildings above the 100-year flood level, and/or acquire properties in flood and high-risk erosion areas for demolition and re-use of the land as open space.
- Page 149, 155, 162: install back-up generators, as needed for short-term relief from power failures, at critical facilities such as sewage pump stations, hospitals and medical centers, nursing home facilities, schools, shelters and government facilities.
- Page 150: construct concrete storm / tornado safe rooms in homes, public buildings, major industrial sites, shopping malls, and other large complexes; and shelter areas in parks, campgrounds, fairgrounds, mobile home parks, and other vulnerable public areas.

NEWAYGO COUNTY – Their plan was updated in June 2021. Top hazards include infrastructure failures, dam failures, floods, wildfires, severe winds, hail, lightning, terrorism, public health emergencies, and ice storms. Numerous past events of these types were documented in the county's hazard mitigation plan, along with two repetitive flood-loss properties. The county's hazard mitigation strategies include:
- Page 494: installation of backup generators at selected facilities.
- Page 494: roadway improvements, including living snow fences, erosion reduction, and stormwater management.
- Page 496: expand provision of storm/weather shelter spaces.
- Page 498: structural flood mitigation measures.
- Page 498, 501: creating firebreaks for wildfire mitigation.
- Page 505: general hazard mitigation activities using FEMA funds.

OAKLAND COUNTY – This plan was updated in November 2023. The county's top natural hazards include floods, snowstorms, severe winds, public health emergencies, tornadoes, ice storms, extreme cold, structural fires, transportation accidents, and hazardous materials site incidents. This is the second most populated county in Michigan, and most of its communities experience significant development pressures. Land use changes have the potential to exacerbate flooding, and already there were several thousand structures identified as at-risk in floodplain locations within

the county. Within the county, an additional plan for Bloomfield Township was updated and approved by FEMA in September 2017. There was also a new plan created for Royal Oak that was approved by FEMA in October 2018. Both of those communities are also covered within the new county plan, however. The county's hazard mitigation plan is in two volumes, and the entire second volume consists of lists of hazard mitigation activities across 526 pages covering the county and 61 participating communities. This level of detail is too much to summarize here, but the county-level hazard mitigation strategies in Volume II of their plan include:

- Page 16, 36: green infrastructure projects and the expansion of green space.
- Page 17: installing additional outdoor warning sirens.
- Page 20: backup power sources at critical facilities.
- Page 25: expanded weather/storm shelters.
- Page 31, 34-35: water/sewer infrastructure improvements.
- Page 35: elevating electrical components, generators, and key mechanical components above base flood elevation.
- Page 41: burial of utility lines, where feasible.
- Page 42: elevate roadways above flood vulnerability levels.
- Page 42-43: install lightning protection on critical infrastructure.

OCEANA COUNTY – Their plan was updated in November 2023. Top hazards include ice storms, snowstorms, severe winds, extreme temperatures, infrastructure failures, structural fires, shoreline hazards, drought, and wildfires. Several local jurisdictions experienced significant development pressures, and the county's plan included action items promoting the inclusion of hazard mitigation issues in local comprehensive plans and zoning ordinances. The county's hazard mitigation strategies include:

- Page 168: dam/spillway repairs and improvements.
- Page 168: improvements to the county's early warning systems.
- Page 169: installation of back-up generators at critical facilities.
- Page 169: road/bridge/culvert infrastructure maintenance/improvements, including living snow fences, erosion control, and stormwater management.

OGEMAW COUNTY – Their plan was last updated in July 2017. Their hazards weren't ranked, but significant ones include severe summer and winter weather, wildfires, infrastructure failures, hazardous materials transportation accidents, structural fire, oil/gas well accident, dam failures, and transportation accidents. Numerous summer and winter storm events were described in the county's hazard mitigation plan, and areas of development were also noted. The county's hazard mitigation strategies include:

- Page 228, 236, 240, 247-249: installing additional emergency warning sirens.
- Page 227, 233, 247, 250, 251: install backup generators at critical facilities and selected locations.
- Page 228, 241: adding concrete safe rooms and shelter areas.
- Page 246-247: dry/wet flood proofing of structures within known flood areas.
- Page 246, 248: elevation of flood-prone structures above the 100-year flood level.
- Page 246, 248: road improvements to increase flood resilience and reduce erosion.
- Page 246, 248: acquisition/relocation of structures within floodplain or floodway areas.
- Page 246, 248: structural flood mitigation projects and the increase of drainage/absorption capacities.
- Page 246, 247, 250-251: storm drainage improvements, including the separation of combined sewer systems.

ONTONAGON COUNTY – This plan was updated and approved by FEMA in August 2022. Top hazards include snowstorms, invasive species, severe winds, shoreline hazards, structural fires, public health emergencies, transportation accidents, floods, infrastructure failures, and ice storms. The county's hazard mitigation strategies include:

- Page 137: install emergency backup generators at critical facilities.
- Page 138: mine-shaft capping and other safety/mitigation measures.
- Page 140: drainage infrastructure improvements and maintenance.
- Page 141: harbor dredging in coordination with USACE.

OSCEOLA COUNTY – Their plan was updated in July 2016. Their hazards weren't ranked, but the most significant appear to include winter weather, tornadoes, fires, severe winds, and flooding. The county's hazard mitigation strategies include:

- Page 3-23: adding outdoor warning sirens at selected parks and campgrounds.
- Page 3-24: structural flood mitigation and vulnerable property acquisition as funds become available.
- Page 3-25: adding additional emergency shelter sites with backup power generators.
- Page 3-25: burial of utility lines, where appropriate.

OSCODA COUNTY – Their plan was updated in July 2021. Top hazards included wildfires, severe winds, ice storms, snowstorms, floods, public health emergencies, tornadoes, infrastructure failures, and extreme temperatures. Development patterns have caused increased vulnerability to wildfires, with more than a 60% increase in rural homes since 1980. Approximately 83% of the county's land is forested. The county's hazard mitigation strategies include:

- Page 9-3: install outdoor warning sirens in specific locations.
- Page 9-4: acquire emergency power generators for critical facilities.
- Page 9-4: purchase NOAA weather radios and distribute to selected facilities.
- Page 9-6, 9-17: establish or install public storm/weather shelter areas at campgrounds, parks, and outdoor recreational facilities.
- Page 9-7: burial of utility lines, where appropriate.
- Page 9-10: create fire-breaks and defensible space in wildfire risk areas.
- Page 9-11: wildfire-fighting water supply and the installation of dry hydrants.
- Page 9-15: lightning protection for key electrical and communication systems.
- Page 9-16: anchoring of mobile homes.
- Page 9-17: install snow fences or living snow fences along key roadway segments.

OTSEGO COUNTY – This plan was updated in June 2021. Top hazards include ice storms and snowstorms, oil/gas pipelines and wells, public health emergencies, wildfires, infrastructure failures, extreme temperatures, and drought. The county's population has tripled since 1960, and several communities were noted as experiencing significant development pressures, particularly around Gaylord. There is also a substantial number of seasonal housing units that causes the county's population to swell during certain times of the year. The county's hazard mitigation strategies include:

- Page 8-10: improvements to water/sewer infrastructure, including pipe insulation.
- Page 8-17: creating high-water marks for hydrologic monitoring.
- Page 8-19: provision of public weather shelters.
- Page 8-20: expansion of county emergency warning systems.
- Page 8-23: integrated water-supply system including dry hydrants, multi-tankers, well-located supplies, etc.
- Page 8-24: install snow fences or vegetation along key roadway segments.
- Page 8-25: burial of utility lines, where appropriate.

OTTAWA COUNTY – Their plan, a combined regional plan with Kent County and the City of Grand Rapids, was updated and approved by FEMA in August 2023. Top hazards include public health emergencies, floods, shoreline hazards, infrastructure failures, pipelines, severe winds, hail, lightning, energy emergencies, and extreme temperatures. The county, squeezed between three metropolitan areas (Grand Rapids, Muskegon, and Holland), experiences strong development pressures throughout many of its local jurisdictions. A substantial floodplain area has been identified in the county, and one community, Robinson Township, developed its own FEMA-approved flood mitigation plan and associated project funds to address several areas of its flood-prone structures near the Grand River. The county's hazard mitigation strategies include:

- Page 161, 759, 778: improvement of warning systems.
- Page 164, 776, 779, 785, 798-799, 809, 814-815: backup systems and emergency power generators at critical infrastructure.
- Page 165-166, 760-762, 810: structural and environmental flood control measures.
- Page 167: provision of green space for heat and flood reduction.
- Page 711: specific multi-hazard activities for Grandville.
- Page 795-796: specific flood mitigation measures for Robinson Township.
- Page 820-822: specific multi-hazard needs for Chester Township.
- Page 832-836: specific multi-hazard needs for Holland.

PRESQUE ISLE COUNTY – Their plan was updated in March 2023. Top hazards include severe winds, infrastructure failures, ice storms, snowstorms, shoreline hazards, extreme temperatures, hail, structural fires, and floods. The county's hazard mitigation strategies include:

- Page 8-7: develop an integrated water supply system including multi-tankers and well-water supply locations.
- Page 8-13: water/sewer infrastructure improvements, including pipe insulation against freeze events.
- Page 8-14: wildfire fuel management techniques and the creation of defensible space around vulnerable structures.
- Page 8-15: burial of utility lines, where appropriate.
- Page 8-24, 8-25: improvements to emergency warning sirens/systems.
- Page 8-25, 8-27: weather shelters for vulnerable populations.
- Page 8-26: emergency backup power generators at critical facilities.
- Page 8-30: install snow fences or vegetation along key roadway segments.

ROSCOMMON COUNTY ï Their plan was updated in September 2016. Their hazards were not ranked, but significant ones appear to include floods, tornadoes, severe weather (summer and winter), fires (wildfire and structural), and hazardous materials incidents. Many previous weather events were described in the county's hazard mitigation plan, along with the identification of one dam that has potentially vulnerable downstream development. Several townships in the county were reported as experiencing significant development pressures, with a large emphasis on tourist and resort attractions. The county contains 17 lakes that are more than 100 acres each and attract residential developments. Seasonal or recreational housing accounts for at least 50% of the housing units in the county. The county's hazard mitigation strategies include:

- Page 109: upgrade the current free notification system to a higher-grade one that allows for the targeted notification of specific populations and areas.
- Page 110: add warning sirens when needed to fill gaps in the county's current warning system.
- Page 111-112: acquire and maintain emergency power generators for back-up power at critical facilities.
- Page 112: construct public safe rooms (shelters) at selected locations.
- Page 113-114: dam repairs for flood mitigation.
- Page 114: plant living snow fences along designated roadways.

SAGINAW COUNTY ï Their plan was updated in June 2023. Top hazards include ice storms, snowstorms, public health emergencies, severe winds, floods, tornadoes, infrastructure failures, extreme temperatures, and structural fires. The county's hazard mitigation strategies include:

- Page 112-113: maintain and improve county drain system.
- Page 113-114: add, update, or replace outdoor warning sirens.
- Page 114-115: flood mitigation for repetitive-loss properties.
- Page 115-116: update/improve emergency mass-notification system.
- Page 116: add remote water monitoring capability at the Mistequay Creek Flood Control Structure.
- Page 116-118: specific flood mitigation projects in several jurisdictions.

ST. CLAIR COUNTY ï Their plan was updated in September 2022. Top hazards include terrorism, infrastructure failures, hazardous materials incidents, cyberattack, public health emergencies, extreme temperatures, transportation accidents, and lightning, but the county's hazard mitigation plan also identifies many properties that have suffered repeated damages from flooding. Leaking underground storage tanks are also a problem throughout St Clair County. The plan includes an entire chapter that aims to integrate hazard mitigation into policy and regulatory frameworks. Much of the county's eastern coastline consists of planned communities, and most of the county's jurisdictions experience significant development pressures. The St. Clair County International Airport has developed a Capital Improvement Program that includes construction projects. With this 2022 update, the county developed Michigan's first all-digital online plan for local hazard mitigation. Within the printed edition that is available, the county's hazard mitigation strategies include:

- Page 179-180: flood mitigation activities for various jurisdictions, including repetitive-loss properties.
- Page 180: burial of utility lines, where appropriate.
- Page 182: infrastructure improvements of various types.
- Page 187-188: streambank stabilization activities.
- Page 190: install backup generators at key facilities.
- Page 190: acquire portable heaters for use in shelters and large facilities.
- Page 192: improve outdoor warning siren system.
- Page 193: provide emergency shelter areas in selected areas.

ST. JOSEPH COUNTY ï Only a draft hazard analysis for the county is on file with MSP/EMHSD. Based on input from the county emergency management coordinator, the top hazards for the county are tornadoes, thunderstorm hazards, flooding, and winter weather (all about equal in priority), followed in priority by petroleum and natural gas pipeline accidents, and hazardous materials incidents (both fixed-site and transportation-related). The county's flood risk includes a concern with the impacts of dam failure. It was reported that at least two pipeline incidents had occurred within a decade.

SANILAC COUNTY ï Their plan dates from October 2020. Top hazards include structural fires, terrorism, infrastructure failures, public health emergencies, ice storms, snowstorms, extreme cold, tornadoes, and hazardous materials incidents. The local hazard mitigation plan identifies new residential development as concentrating around existing cities, villages, and the lakeshore. The county's hazard mitigation strategies include:

- Page 143: maintain/improve warning siren system throughout the county.
- Page 143: acquire/install emergency power generators and battery back-up packs at critical facilities.
- Page 145: culvert replacement/improvement as needed.

- Page 146: install sleeves in sanitary sewer mains to reduce external seepage.
- Page 148: purchase and distribute NOAA weather radios to selected facilities.
- Page 148: plant living snow fences along designated roadways.

SCHOOLCRAFT COUNTY – Their plan was updated in March 2023. Top hazards include snowstorms, ice storms, structural fires, severe winds, wildfires, transportation accidents, hazardous materials transportation incidents, infrastructure failures, public health emergencies, and lightning. The northern part of the county averages about 120 to 130 inches of snow per year, and the southern part averages about 60 to 70 inches per year. The southern part of the county includes the important transportation route of US-2, whose uses (along with nearby railroad tracks) include the transportation of hazardous materials. In the northern part of the county is M-28, and another important railroad line that lies nearby. Two-thirds of the county's population lives within a mile of a trunk-line or railroad. Waterfront properties have experienced a trend in which natural areas are being converted into residential and cottage areas. Development along US-2 is expected to intensify, along with the conversion of seasonal homes along lakes and streams into year-round occupancy. Many housing units are seasonal or recreational. The county's hazard mitigation strategies include:

- Page 5-3, 5-6, 5-7, 5-12: maintain/expand emergency warning sirens, notification systems, reverse 9-1-1, Rave Alert, and IPAWS.
- Page 5-4: installing snow fences or living snow fences at key roadway segments.
- Page 5-4: improve weather shelters for vulnerable populations, including the use of emergency power generators.
- Page 5-6: burial of utility lines, where appropriate.
- Page 5-6: improve insulation of water infrastructure.
- Page 5-10: use of sump pumps, check valves, and backflow preventers for flood mitigation.
- Page 5-11, 5-12: use of emergency backup power generators at key facilities.

SHIAWASSEE COUNTY – Their plan was updated in September 2016. Top hazards include severe winds, tornadoes, floods, snowstorms, weapons of mass destruction, ice storms, extreme cold, lightning, hail, and hazardous materials incidents. Infrastructure failures occur as a result of weather events. Past flood events have included up to 9 feet of basement flooding, backed-up sewers, multiple closed streets, and overwhelmed culverts and bridges. The media reports county removal of the Shiatown Dam in 2022. Hazard mitigation strategies include:

- Page 113, 117, 121: enhance warning systems.
- Page 115: flood mitigation information.
- Page 118: repair and/or remove dams where appropriate.
- Page 122: employ generators for back-up power at critical facilities.
- Page 144-146, 148: specific FEMA-fundable hazard mitigation activities.

TUSCOLA COUNTY – Their plan was updated in October 2022. Top natural hazards included severe winds, lightning, snowstorms, ice storms, hail, tornadoes, and shoreline hazards, and top hazards of technological or human-related types include structural fires, transportation accidents, public health emergencies, transported hazardous materials, and terrorism. The City of Vassar also had a flood mitigation plan on file from 20 years before (approved under older FMA program standards) and has accomplished many improvements to alleviate the city's flood impacts, such as removing the Vassar Dam and building two diversion pipes with back-flow prevention structures at their outlets in the Cass River at Vassar. Upgrades to sewer and water systems have occurred in the City of Caro, Village of Millington, and the Village of Akron. Denmark Township had also received USDA grants and loans to install a sanitary sewer system. The county's hazard mitigation strategies currently include:

- Page 143: expanding the county's emergency warning system.
- Page 143: use of emergency backup generators at critical facilities.
- Page 144: expand weather shelter facilities in the county.
- Page 145: flood mitigation and expansion of drainage infrastructure.
- Page 146-148: local jurisdictions associated with the above activities.

VAN BUREN COUNTY – Their plan was updated in May 2016. Top hazards include ice storms and snowstorms, severe winds, lightning, structural fires, hazardous materials (fixed site and transportation), drought, and infrastructure failures. Over 1,200 structures were identified as being within flood-prone areas. Some areas in the county have experienced significant development pressures. Within the county, a plan for the Pokagon Band of Potawatomi was FEMA-approved in July 2012. The county's hazard mitigation strategies include:

- Page 121, 131, 133: improve and/or install public warning systems.
- Page 124-125: construct storm shelters in mobile home parks where needed, and at the county fairgrounds.
- Page 126: install generators at critical facilities.
- Page 130, 133: flood mitigation and culvert improvements, especially in Lawrence Township at 68th Avenue and Territorial Road, plus areas in Arlington Township.

- Page 131: install stormwater relief drains in Hartford for flood mitigation in an older neighborhood.

WASHTENAW COUNTY – Their plan dates from July 2005. Top hazards included severe winds, tornadoes, hail, lightning, infrastructure failures, ice storms, snowstorms, hazardous materials incidents, and extreme temperatures. Most of the county feels strong development pressures, and the county plan identifies various development trends. Within the county, a separate plan for Ann Arbor was updated and approved by FEMA in December 2022, and a plan for Eastern Michigan University had been developed and approved by FEMA in March 2013. A separate plan for the University of Michigan (including its largest Ann Arbor campus) was updated in October 2019. The county plan's hazard mitigation strategies include two volumes of strategies for local governments within the county. Highlights from these hundreds of pages (in which page numbering begins afresh in *each* community subsection) include:

- City of Ann Arbor, page 16-22: remove dams, replace and upgrade emergency generators at key facilities, upgrade warning siren system, flood mitigation (acquisition and modifications).
- Ann Arbor Township, page 9-13: add warning sirens and purchase emergency backup generators.
- Augusta Township, page 7-11: installation of warning sirens, emergency generators, and construction of safety shelters.
- Barton Hills Village, page 7-10: install warning sirens, install emergency generators at water wells.
- City of Chelsea, page 9-12, install warning sirens, install emergency generators at key city buildings, and provide a new emergency shelter for mobile home park residents.
- Dexter Township, page 7-12: new warning sirens in selected facilities, install emergency generators, install a public warning system to alert downstream residents/businesses in the event of a dam failure, giving them time to evacuate.
- Village of Dexter, page 7-12: install emergency generators at selected facilities, repair the Main Street Bridge over Mill Creek.
- Lima Township, page 7-12: install warning sirens, emergency generators, and perform dam repair work.
- Lodi Township, page 9-12: install new warning sirens strategically located to maximize community coverage, install an emergency generator at the township hall, and construct an emergency shelter at the Washtenaw Farm Council Fairgrounds.
- Lyndon Township, page 7-12: install warning sirens, and at least one emergency generator at the Township Hall.
- City of Milan, page 7-11: install emergency generators at the City Hall, police station and fire station.
- Northfield Township, page 7-13: install warning sirens, emergency generators, and detention ponds or other appropriate measures to alleviate flooding around Horseshoe Lake.
- Pittsfield Township, page 7-14: install warning sirens and emergency generators.
- Salem Township, page 7-11: install warning sirens, and construct safety shelters.
- City of Saline, page 9-13: install warning sirens, emergency generators, and construct a shelter for the manufactured housing communities.
- Saline Township, page 7-11: install warning sirens and emergency generators.
- Scio Township, page 7-11: install warning sirens, install an emergency generator at the Township Hall.
- Southwest Washtenaw Region (Bridgewater Township, Freedom Township, Manchester Township, the Village of Manchester, and Sharon Township), page 9-15: install warning sirens, emergency generators, replace the culvert along Schleweis Road, replace the Furnace Street Bridge in the Village of Manchester, and perform dam repair and maintenance.
- Superior Township, page 7-12: install warning sirens and emergency generators.
- Sylvan Township, page 7-12: install warning sirens, emergency generators, and perform road improvements at the intersections of Kalmbach and I-94 and Werkner Road and M52.
- Webster Township, page 7-11: install warning sirens and emergency generators.
- York Township, page 7-11: install warning sirens and emergency generators.
- City of Ypsilanti, page 7-17: install emergency generators, warning sirens, and repair the Peninsular Park Dam.
- Ypsilanti Township, page 7-18: install warning sirens, emergency generators, and safety shelters throughout the township.

WAYNE COUNTY – Their plan was updated in May 2021. Top hazards include infrastructure failures, public health emergencies, terrorism, ice storms, snowstorms, floods, extreme temperatures, transported hazardous materials, and shoreline hazards. There are also multi-hazard plans developed for some jurisdictions within Wayne County, notably the City of Detroit's update, in March 2022, and a separate plan for the University of Michigan, including the Dearborn campus, that was updated in October 2019. Wayne County is the most heavily populated county in Michigan, containing about 18 percent of the state's population, and has a great number of communities that are under strong development pressures. Power failures can be particularly harmful to vulnerable residents in heavily urbanized areas of the county where heat effects tend to be exacerbated. The county's hazard mitigation strategies include:

- Page 191-219: various community-specific hazard mitigation ideas, too numerous to list here.
- Page 221-222, 226: establish an adequate number of warming/cooling centers to provide relief to those with need.
- Page 221-222: flood mitigation activities in coordination with USACE.

- Page 224-225: improvements to sewer/drain infrastructure, to achieve flood mitigation.

WEXFORD COUNTY – Their plan was updated in August 2015. Top hazards included floods, tornadoes, severe winds, ice storms, snowstorms, wildfires, hail, and drought. Snowfall events may involve up to 15 inches of snow that causes road blockage, accidents, and power failures. Strong winds are a frequent cause of power failures, and there is a high damage potential affecting the seasonal population influx and festivals held in various towns and villages throughout the county. Flood risks have been identified near Lake Cadillac, Lake Mitchell, Silver Creek, the Manistee River, and Fletcher Lake. The county's hazard mitigation strategies include:

- Page 31: install additional public warning sirens.
- Page 31: install storm/weather shelters for campgrounds, mobile home parks.
- Page 31: anchoring of mobile homes.
- Page 31: burial of utility lines, where appropriate.
- Page 32: drainage improvements, including culvert expansion.
- Page 32: floodproofing of structures.

Section 3: Local Planning Challenges and Barriers

The FEMA requires the MHMP to provide information related to the barriers local governments face in updating, adopting, and implementing FEMA approved plans and mitigation activities. While some of the challenges have already been discussed in Chapter 6, additional material is provided here and, where possible, ties this commentary to newer programs and potential capability improvements.

The use of grants such as HMA often requires a substantial amount of work, which makes their use impractical for certain jurisdictions whose staff or budgets are limited. Discussions have occurred over the last several years to try to reduce administrative requirements and time needed for hazard mitigation grants and to supplement existing FEMA grants with additional funding types. An example is through the STRLF which provides a revolving loan fund program for resilience activities.

Preparedness and response capabilities often receive more attention than mitigation, especially hazard mitigation has historically been thought of primarily in terms of flood hazards and, to a lesser extent, wildfires, and severe winds. For more than 20 years, state guidance has identified hazard mitigation actions for all types of hazards, but many locally selected activities often involve ideas that are technically considered preparedness activities rather than hazard mitigation. Even though preparedness often feels extremely cost-effective for some hazard types, the hazard analysis component of a hazard mitigation plan is intended to help justify specific costs that might be offset by the application of FEMA project grants. Local plans need to focus more on pinpointing and justifying a more limited range of federally fundable hazard mitigation projects and not divert so much attention to the evaluation of preparedness activities.

It is understood that government agencies (at all levels) are limited in their ability to regulate or control individuals and firms. A compelling need is required in order to make strong regulations politically feasible and justifiable, and an informed study is usually required to understand risks and justify various costs required to reduce those risks. It is easier for governments to encourage individual responsibility (i.e., public awareness and education), as a kind of advisor, rather than to regulate personal actions and property or to implement its own projects specifically to reduce public risks. Community comprehensive plans are similarly reluctant to impose private costs upon individuals and firms (or to recommend major capital improvements that might be too burdensome upon local budgets) that might achieve the often-abstract goals of risk reduction. The value of higher levels of government for assisting local communities with disaster response is widely recognized, but the right of government to impose preventive regulations and policies often is not, particularly when they involve many sets of bureaucratic procedures and conditions. In cases involving clearly defined natural risks in specific areas, such as floodplains, efforts, and costs are easier to justify, even though many persons have difficulty understanding the probabilistic aspects of hazard risks. Many studies and plans have been made to examine Michigan hazards. Major natural hazards that are huge priorities in other states, such as tsunamis, sea-level rise, hurricanes, and earthquakes, are not particularly relevant for Michigan's communities.

Many of Michigan's hazard-prone areas are associated with appealing features. For example, floodplain locations are often very scenic and desirable places to be, except when a flood occurs. Woodlands are also scenic and desirable, except when devastated by wildfires. Many weather hazards threaten all locations in Michigan, although some are far more threatened than others. The levels of expectation, preparedness, and resilience vary from community to community. Snowstorms, for example, have greater magnitude in the northern parts of Michigan, but do less damage there than in the southern parts of the state, according to official records. This is seemingly due to greater preparedness in the north. Would similar levels of preparedness be considered cost-effective in the southern parts of the state? Perhaps not. This is a tricky thing to calculate, except at a local level.

In Michigan, hazard mitigation's well-established record has emphasized flood risks, which are indeed Michigan's most damaging natural hazard, and has a long history of federally funded flood mitigation projects. The guidelines for hazard mitigation planning require the generation of activities that are eligible for federal funding. The installation of warning systems may be considered to be a preparedness activity, but it has been recognized as a federally fundable project type under certain categories of hazard mitigation assistance (in recognition of its protective effects upon human safety).

The FEMA has increased its emphasis on the protection of human life, and it is now easier to justify the expense of storm shelters and the installation of generators at critical facilities. Progress has also been made toward funding the re-design and expansion of infrastructure to be higher-capacity and more resilient through the introduction of BRIC. Further, although it remains technically ineligible to fund most maintenance and repair activities under available federal funds, even when those would be useful for hazard mitigation purposes (as when dredging drainage channels and proactively clearing them of ice or woody debris), the newer HHPD program should help to address a long-term need for the maintenance and repair (or safe removal) of qualifying dams that have known and substantial risks associated with them. Further consideration should be given to how similar activities might be included for funding other types of hazard vulnerability reduction, in cases where they are found to be very cost-effective in preventing or reducing damages and threats to life. For example, the funding of emergency power generators should be increased.

As part of FEMA's updated hazard mitigation planning policy, an additional goal of equity considerations was included within the mandates for hazard mitigation plans. In September 2023, new targeted CDRZ communities (including 10 census tracts in Michigan) marked the inclusion of equity-based needs as one of three primary means for targeting locations for resilience programs. The ten Michigan zones are located within the counties of Lapeer, Midland, Montcalm, Shiawassee, Tuscola, Washtenaw, and Wayne.

Although the concept of hazard mitigation is often presented in terms of an all-hazards approach, the available strategies for some hazards may not be readily fundable through available resources. Local programs have often found it difficult to define risk reduction within pre-defined boundaries of projects that are eligible for funding. Where there is a known risk, there should be a corresponding risk-mitigation strategy that can be implemented with existing resources. Additional work is needed to help plans flow logically from (1) identifying each hazard to (2) proposing actions that reduce its risks.

An increase in documented climate change impacts has occurred over the past several years. Widespread wildfire and drought impacts in other areas of the country and world have provided dramatic examples of climate-related risks, and smoke from Canadian wildfires recently caused various air-quality alerts and advisories throughout Michigan. Additional research, education, and outreach are still needed to further identify which vulnerabilities are likely to appear and worsen as a result of known climate trends. For example, as precipitation levels have increased, the drainage infrastructure is less able to handle the worst rain events. Lake level fluctuations, problems with water quality, and harmful algal blooms will need to be more thoroughly explored in local and state hazard analyses.

There have been widespread misunderstandings about how the development of local hazard mitigation plans does or does not tie in with various government mandates. For example, it is often believed or claimed that the lack of a local hazard mitigation plan will make communities and their members ineligible for *any* disaster assistance from higher levels of government. Although this is untrue, it also seems certain that this mistaken belief is one of the things that has encouraged many local hazard mitigation plans to be developed and updated over time. For those who perceive the main benefit of a hazard mitigation plan in terms of their ability to access grant money, the incentive of local communities to go through the increasingly rigorous process of developing these plans sometimes declines, when someone calculates that the costs of developing a plan are higher than the grant funds they are likely to receive as a result. In some instances, these motivations, as well as the rather involved regulatory standards for local hazard mitigation grants and plan reviews, have *decreased* the willingness of some jurisdictions to complete their plan updates every five years.

Hazard mitigation planning, including the potential to receive federal project funds as a result, should be perceived as being intrinsically worth the efforts that it requires. In some cases, the local share requirements of an expensive grant may make projects seem too difficult to fund even when a plan is in place, and the bureaucratic requirements involved in obtaining such grants may be another obstacle that feels difficult to overcome. Michigan has been exploring its capacity to operate a state-level hazard mitigation fund that might help to address issues such as grant match requirements for expensive projects, but this capacity for systematic state-level funding is not yet in place.

These are the dilemmas within which local hazard mitigation plans have been developed in Michigan for about the past 20 years. The FEMA has defined a "benefit" very broadly, indifferent to whether those benefits are realized by the government itself, private stakeholders, or some combination thereof. This broad definition is a very good thing, but not necessarily one that has been shared by all agencies that have the capacity to promote hazard mitigation. Most local programs are to be greatly applauded for the degree that they have succeeded in developing and maintaining updated local plans over recent years, in spite of the great (and often increasing) challenges.

The development of a hazard mitigation plan does in most cases help agencies and communities to understand their hazards, coordinate with each other, and thereby prepare and respond better to their next emergencies. In addition to these intrinsic benefits, a FEMA-approved hazard mitigation plan opens the possibility of funding local hazard mitigation projects (i.e., if the projects meet FEMA's criteria and compete favorably with projects proposed by other agencies). A normal expectation for today's local emergency managers is to arrange for their area's local hazard mitigation plan to be updated approximately every five years, and FEMA's available planning grants often make this possible through the use of "soft" local match (i.e., the value of people's time when involved in local planning processes), rather than a "hard" match of cash that might strain a local budget.

Appendix 8: High Hazard Potential Dams

Certain high hazard potential dams are eligible for technical, planning, design, and construction assistance through the federal HHPD Grant Program, sometimes referred to as the Rehabilitation of HHPD Grant Program. EGLE is the authorized SAA, with the EGLE Dam Safety Program (DSP) coordinating with MSP/EMHSD and other stakeholders as appropriate. For example, USACE records were used during the initial assessment phase for this program. Dam owners and local Emergency Managers also had prior involvement in the development of a dam's EAP.

Dams must meet the following baseline eligibility criteria: (1) prior assessment as high hazard potential, (2) an approved EAP on file with EGLE, (3) an assessed dam condition of poor or unsatisfactory, (4) in general, non-hydroelectric dams, (5) not constructed under the Department of the Army or other federal authority, (6) judged as not meeting minimum EGLE dam safety standards, (7) judged as posing an unacceptable risk to the public, (8) a calculated population at risk (PAR) for catastrophic failure, (9) a potential for environmental impacts from such a failure, and (10) a coordinated interest with dam owners and local stakeholders. Final eligibility is determined in conjunction with FEMA and where a local hazard mitigation plan has been approved as being HHPD Grant Program compliant.

Baseline Eligible Dams Under the HHPD Grant Program (as of January 2024)

DAM NAME	NID #	CONDITION*	TYPE	BUILT	PAR	COUNTY	OWNER
Allegan City Dam	MI00489	Poor	Earth Gravity	1900	114[c]	Allegan	City of Allegan
Menasha Dam	MI00522	Poor	Gravity	1886	93[d]	Allegan	City of Otsego
Trowbridge Dam	MI00604	Poor	Gravity Earth	1899	297[d]	Allegan	MDNR Wildlife
Cornwall Creek Dam	MI00246	Poor	Earth	1966	37[c]	Cheboygan	MDNR Fisheries
Shamrock Lake Dam	MI00622	Poor	Earth	1962	22[c]	Clare	City of Clare
Edenville Dam	MI00549	Unsatisfactory	Earth Gravity	1924	10,000[b]	Gladwin	Four Lakes Task Force
Secord Dam	MI00547	Unsatisfactory	Earth Gravity	1925	10,000[b]	Gladwin	Four Lakes Task Force
Smallwood Dam	MI00548	Unsatisfactory	Earth Gravity	1925	10,000[b]	Gladwin	Four Lakes Task Force
Sanford Dam	MI00550	Unsatisfactory	Earth Gravity	1925	10,000[b]	Midland	Four Lakes Task Force
White Cloud Dam	MI00526	Poor	Earth Concrete	1872	11[d]	Newaygo	City of White Cloud
Portage Plant Dam	MI00374	Poor	Earth	1922	81[a]	Saint Joseph	Portage Power Company
Manistique Papers Dam	MI00377	Poor	Concrete	1919	300[c]	Schoolcraft	Manistique Paper, Inc.
Peninsular Paper Dam	MI00500	Poor	Gravity	1867	59[c]	Washtenaw	City of Ypsilanti

* Condition ratings: Satisfactory, Fair, Poor, Unsatisfactory. Unsatisfactory means a safety deficiency is recognized that requires immediate or emergency remedial action for problem resolution. Click HERE for National Inventory of Dams terminology.
[a] PAR (population at risk). [b] PAR estimated on evacuations from May 19, 2020, flood event.
[c] PAR calculated from previous inundation area. [d] PAR calculated with inundation area from HEC-RAS 2d flow model.

The Little Black River Dam (Cheboygan County) and Buttermilk Creek Detention Dam (Ottawa County) were deemed eligible in prior editions of this plan but no longer qualify. The Barton Dam (Washtenaw County), overseen by the Federal Energy Regulatory Commission (FERC), is currently not eligible for the HHPD program because of its hydroelectric status.

Baseline Eligible Dams Under the HHPD Grant Program
(Also Subject to Local Hazard Mitigation Plan Requirements)

(source: EGLE DSP)

Dam Vulnerability Assessment

Dam Name	Vulnerability / Deficiency
Cornwall Creek Dam	Does not meet desirable factors of safety for slope stability due to ineffective clay core and high phreatic surface.
Portage Plant Dam	An engineering inspection is overdue.
Manistique Papers Dam	Currently, there is no legal owner of the dam due to bankruptcy and foreclosure. Significant structural deterioration of all concrete components. Difficulty with managing and operating gates causes concerns regarding flow management.
Peninsular Paper Dam	Structural components have significant deterioration. The abutment walls are deteriorating along the bottom of the spillway. The deterioration has advanced since the previous inspection report.
Allegan City Dam	Stoplogs are failing and the deck to operate and maintain the stoplogs is in poor condition. The powerhouse is in poor condition.
Menasha Dam	Structural components have significant deterioration. The concrete principal spillway and concrete abutment walls have significant cracking and spalling that need to be investigated by an engineer.
Shamrock Lake Dam	Spillway lacks adequate hydraulic capacity.
White Cloud Dam	Does not have adequate spillway capacity. The dam has overtopped and been close to overtopping during recent rain events.
Secord Dam	Spillway lacks adequate hydraulic capacity and embankments lack desirable factors of safety for potential instability modes.
Smallwood Dam	The 2020 flood exposed concerns for erosion and embankment loss at auxiliary spillway. Additionally, erosion on downstream slopes around primary spillway identified a need for additional erosion protection.
Edenville Dam	Dam failed on May 20, 2020. Failure mode was identified as static liquefaction induced by elevated water levels. Spillways lacked adequate hydraulic capacity.
Sanford Dam	Dam failed on May 20, 2020. Failure mode was overtopping due to upstream failure of Edenville Dam. The former dam relied on fuse plug spillway for increased capacity.
Trowbridge Dam	Does not have adequate spillway capacity. Overtopping flow would lead to failure of the left embankment.

(source: EGLE DSP)

Inundation mapping for these dams is available at the end of this appendix, which also shows select critical facilities in potentially impacted areas. The separately published MHA contains additional information on more general dam related vulnerabilities in its Dam and Levee Failures chapter, including for dams that are not eligible for the HHPD Grants Program.

Vulnerability and Risk Methodologies

The PAR Determination: The population data is from the HIFLD LandScan Conus day and night population estimates. The population grid size is large so data may miss or overspread population data. The DSP is currently working on a tool to refine population data to the parcel level. The 2020 Block Census Data, day and night populations, will be spread out evenly to parcels that have property addresses.

Inundation Mapping: No survey information is currently available for downstream river/channel cross-sections. The DSP plans to obtain survey information of river/channel cross-sections (time restraints of available staff being the main constraints). No survey information of culverts/bridges in the downstream river/channel were used (culverts were removed and modeled as a continuous stream). Hydrology downstream of a dam is not included in the inundation analysis. The DSP is working on a tool to effectively account for hydrology downstream and add that information to the current HEC-RAS models. The same n value was used for the 2d flow area (the DSP is working on a tool to determine n-values based on an internal Michigan GIS land use database and the USGS land use database, and then add that information to the current HEC-RAS model). The 2d flow meshes were not refined to match topography in the floodplain. The DSP will continue to improve the models as time allows and areas change.

Embankment Overtopping and Piping Breach Hydrograph: Many dams do not have embankment condition soil information, so a conservative soil condition was assumed. Funding would need to be obtained to perform soil borings and get soil information to update the DLBreach model. There is also uncertainty in the erodability rate for cohesive soils. When DLBreach models a breach failure for cohesive soils the breach progression is based upon the erodability rate. However, the DSP does not currently have a complete understanding of the erodability rate variation of different soil types. Further research to better understand this erodability rate is planned.

Dam Safety Program Actions
The DSP is actively engaging local emergency managers and eligible dam owners to assist them in having HHPD Grant Program compliant local hazard mitigation plans. There are currently two dams that are utilizing HHPD Grant Program funds to rebuild dams that are in unsatisfactory condition. The dams are being built with the most current dam safety standards and updated operations and maintenance plans.

The DSP also offers a separate Dam Risk Reduction Grant Program (a program handbook can be found HERE) to fund projects that reduce risks at dams. Through this program, the DSP has awarded roughly $15 million to fund four high hazard and four significant hazard dam removal projects, as well as two high and four significant rehabilitation projects.

The DSP has developed a tool that uses DLBreach to help predict overtopping and piping failure hydrographs and has determined inundation boundaries and PARs for all the dams eligible for HHPD Grant Program funding. The DSP has received approval to hire a staff member to coordinate with dam owners and local emergency managers on developing up to date EAPs and hazard mitigation plans. The DSP has monthly meetings with FERC to address each other's concerns and comments. The DSP is additionally working towards utilizing a risk scoring tool to help prioritize dam enforcement and compliance actions, as well as creating inundation maps for all high hazard dams in order to share inundation boundaries with the public.

General Prioritization Formula
The DSP uses the following equation: Score = (Capacity + Discharge + Properties) x Hazard x (PAR + Environment) x Justice Factor, where:

Discharge = related to the design storm flow rate.
Capacity = related to the design storm flow minus the spillway capacity (if the dam has enough capacity, it is 0).
Properties = related to the height and impoundment area of the dam.
Hazard = related to the Hazard Potential and condition of the dam.
PAR = related to the population at risk during a dam failure.
Environment = related to the environmental risk due to the dam failure.
Justice Factor = related to the MiEJScreen tool for disproportionately impacted communities.

For priorities based on emergencies, the DSP has a fund that allows for emergency action. This may involve a drawdown, or an engineer will be hired to design a cost effective, environmentally sound, and feasible project.

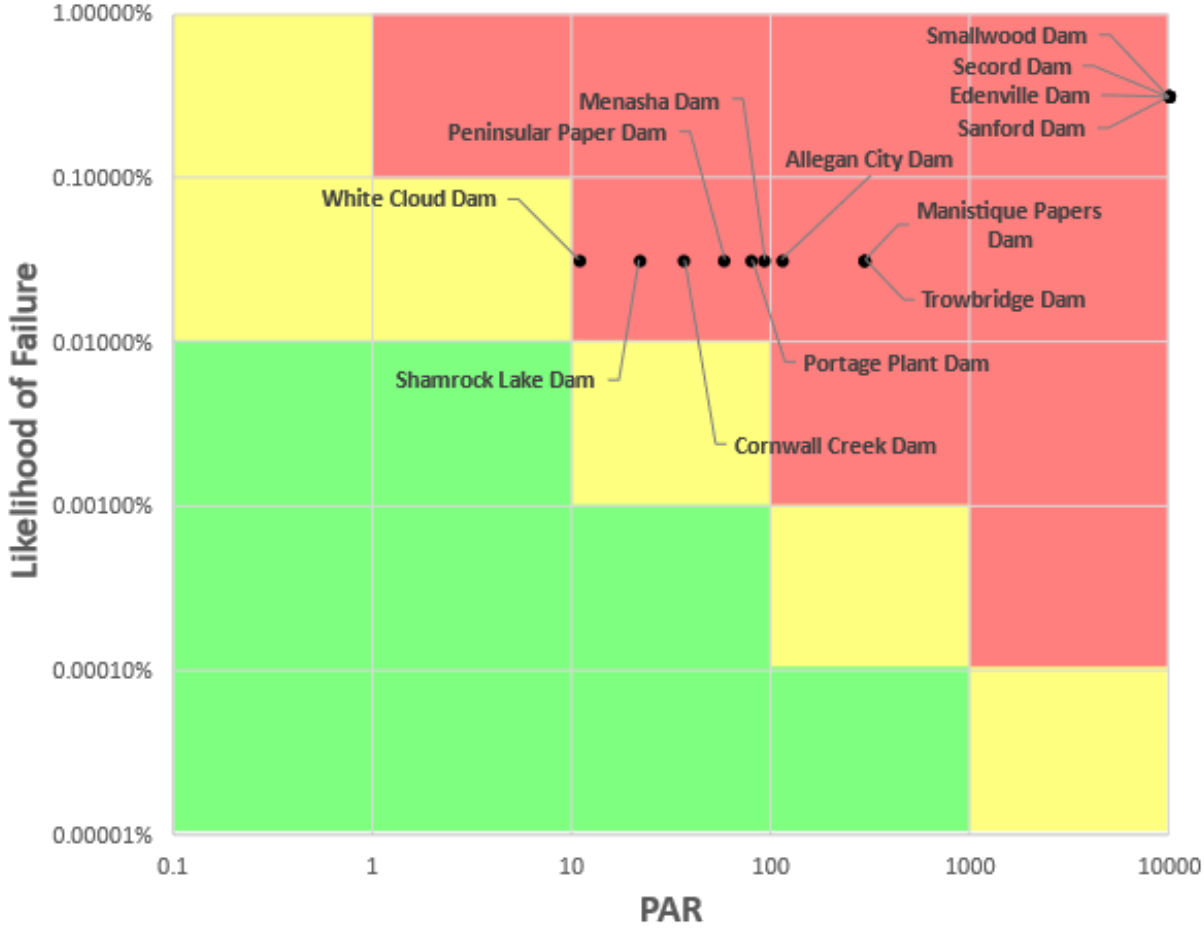
Dam Risk Reduction Grant Program
In addition to the HHPD Grant Program, the EGLE DSP Dam Risk Reduction Grant Program is also available. These applicants are scored using the following equation: Score = Application + (Capacity + Discharge + Properties) x Hazard x Purpose x Project x (PAR + Compliance + Environment) x Justice Factor, where:

Application = related to how well the application was filled out.
Discharge = related to the design storm flow rate.
Capacity = related to the design storm flow minus the spillway capacity (if the dam has enough capacity, it is 0).
Properties = related the height and impoundment area of the dam.
Hazard = related to the Hazard Potential and condition of the dam.
Purpose = related to whether or not the dam serves a purpose to the environment or the public.
Project = related to whether or not the project will address the deficiencies and risks.
PAR = related to the population at risk during a dam failure.
Compliance = related to whether the current owner follows the state's regulatory statutes for dam safety.
Environment = related to the environmental risk due to the dam failure.
Justice Factor = related to the MiEJScreen tool for disproportionately impacted communities.

Other potential options from the State include a DNR Fisheries Habitat Grant. At the federal level, the Natural Resources Conservation Service (NRCS) also works with local communities and watershed project sponsors to address the impacts of aging dams through their Watershed Rehabilitation Program.

HHPD Grant Program Matrix

This matrix examines both the likelihood of dam failure and the consequence of failure to the affected population as it relates to Michigan dams that have been considered, scored, and determined as eligible for the HHPD Grant Program.



(source: EGLE DSP)

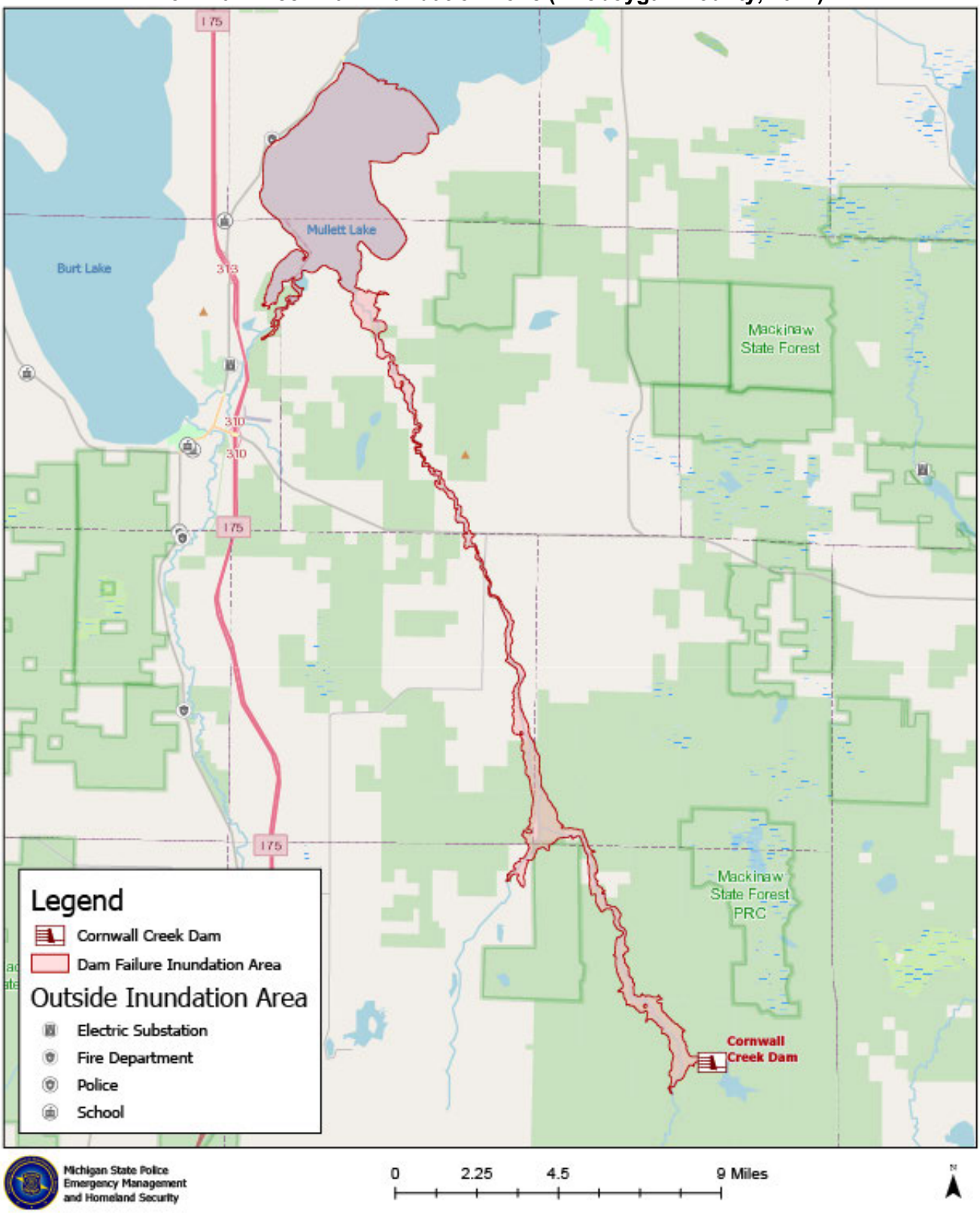
Other Scoring Considerations

For both the HHPD Grant Program and EGLE DSP grants, scores are compared to the total cost of the project to identify the cost to benefit ratio (another factor in the selection process). In addressing Life Loss Potential Determination (LLPD) tool options, scoring does not currently account for use of a specific life loss potential tool. FEMA is currently working on such a tool, and the DSP is also developing a similar tool in parallel that will be compared to FEMA's efforts.

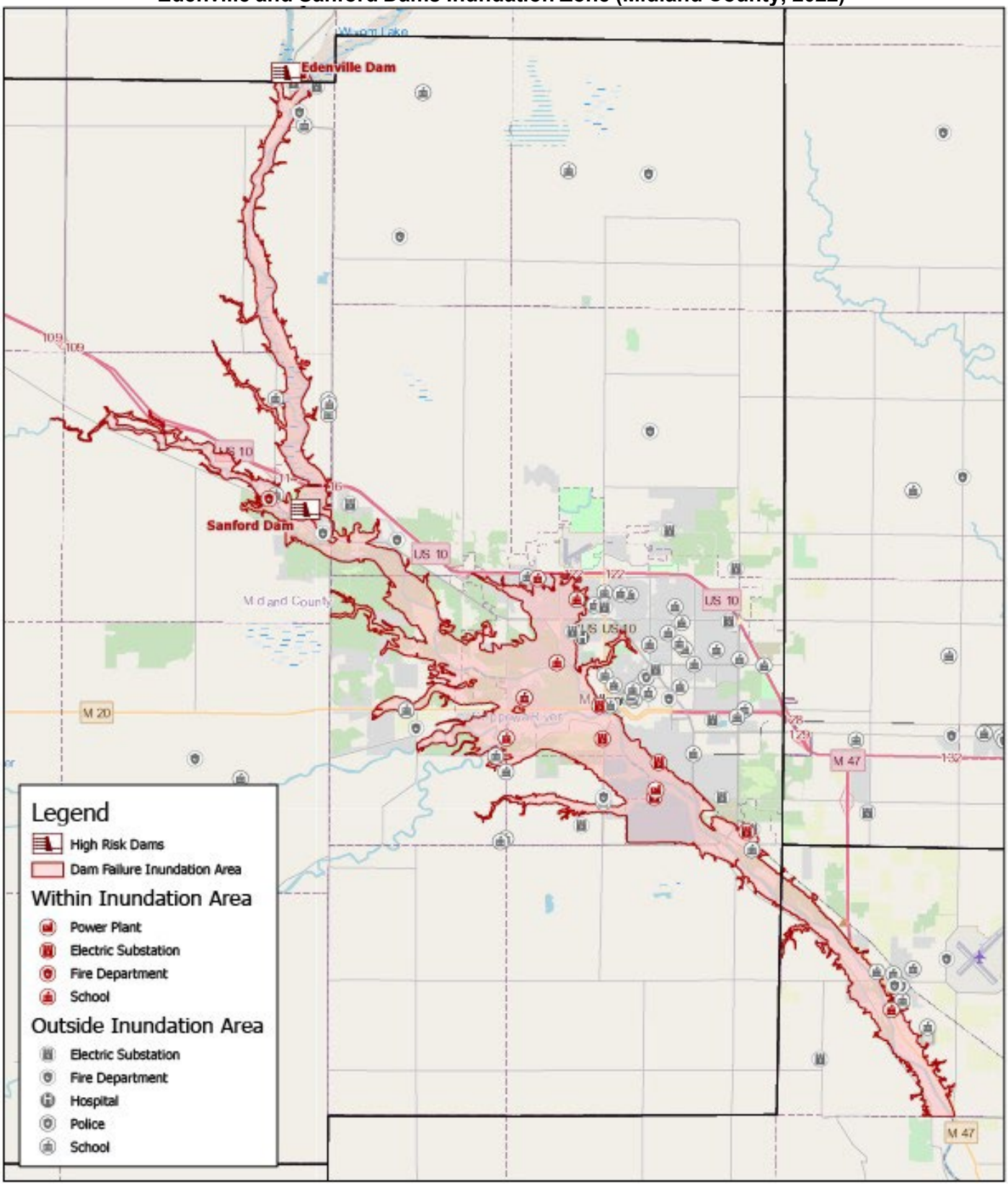
Inundation Mapping

Base maps are included for the Cornwall Creek Dam (owned by the State of Michigan), dams associated with Federal Disaster 4547-DR (2020), and other HHPD Grant Program eligible dams. Modeled inundation zones can be affected by a variety of unique factors that may be unknown until the time of dam failure (including the failure of other upstream dams, if any). Maps begin on the following page.

Cornwall Creek Dam Inundation Zone (Cheboygan County, 2022)

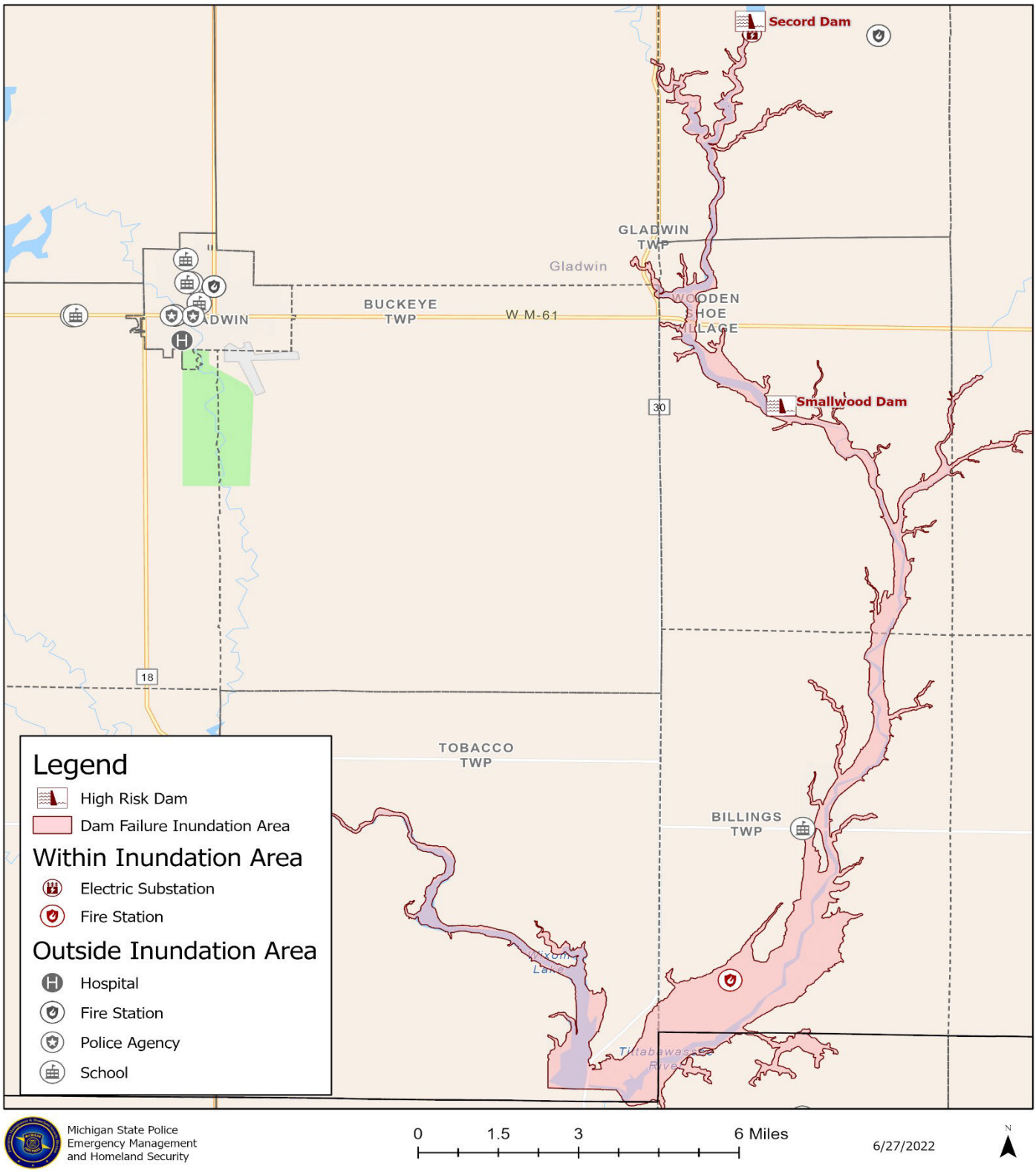


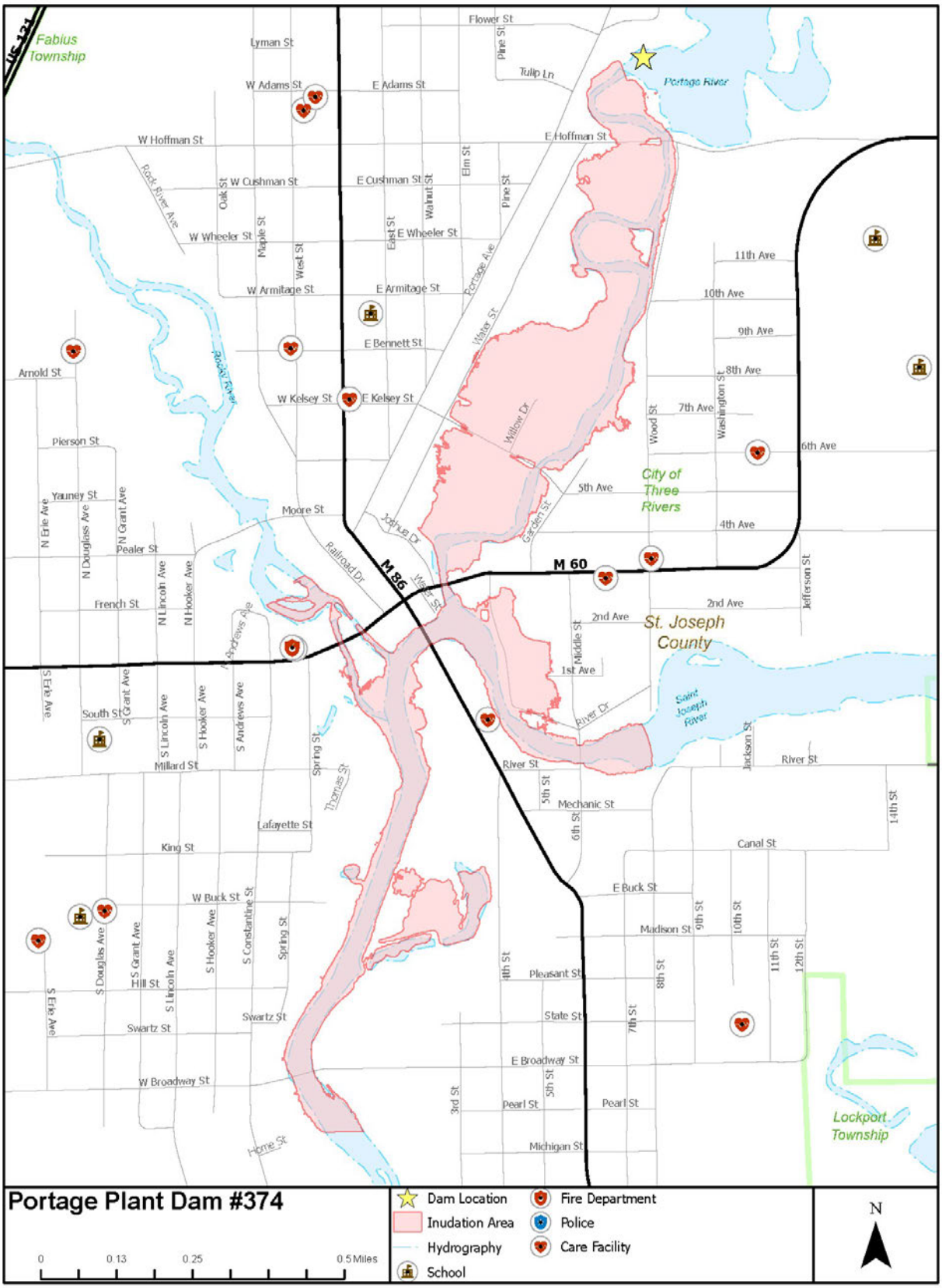
Edenville and Sanford Dams Inundation Zone (Midland County, 2022)



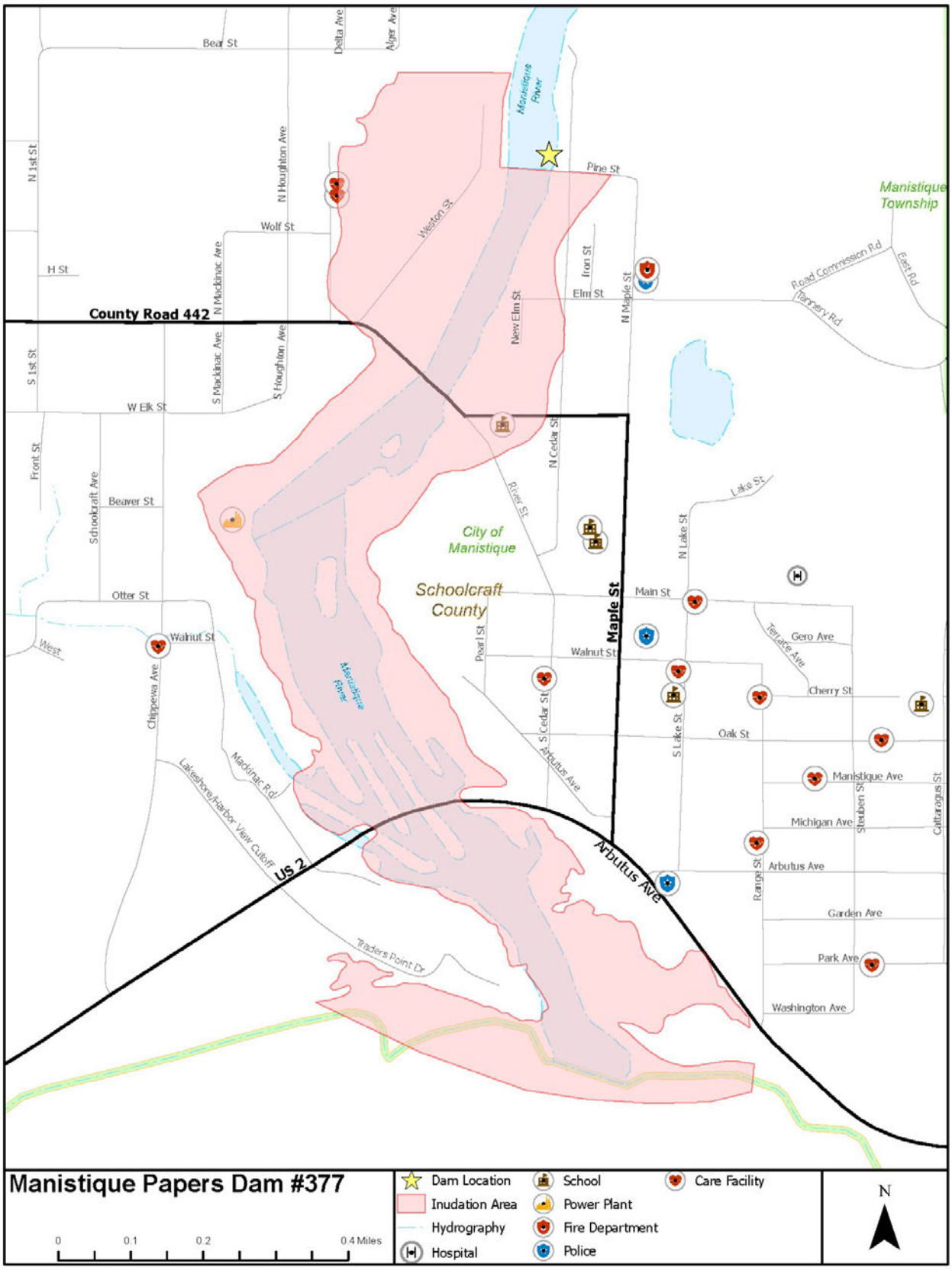
(source: MSP/EMHSD, June 2022)

Secord and Smallwood Dams Inundation Zone (Gladwin County, 2022)

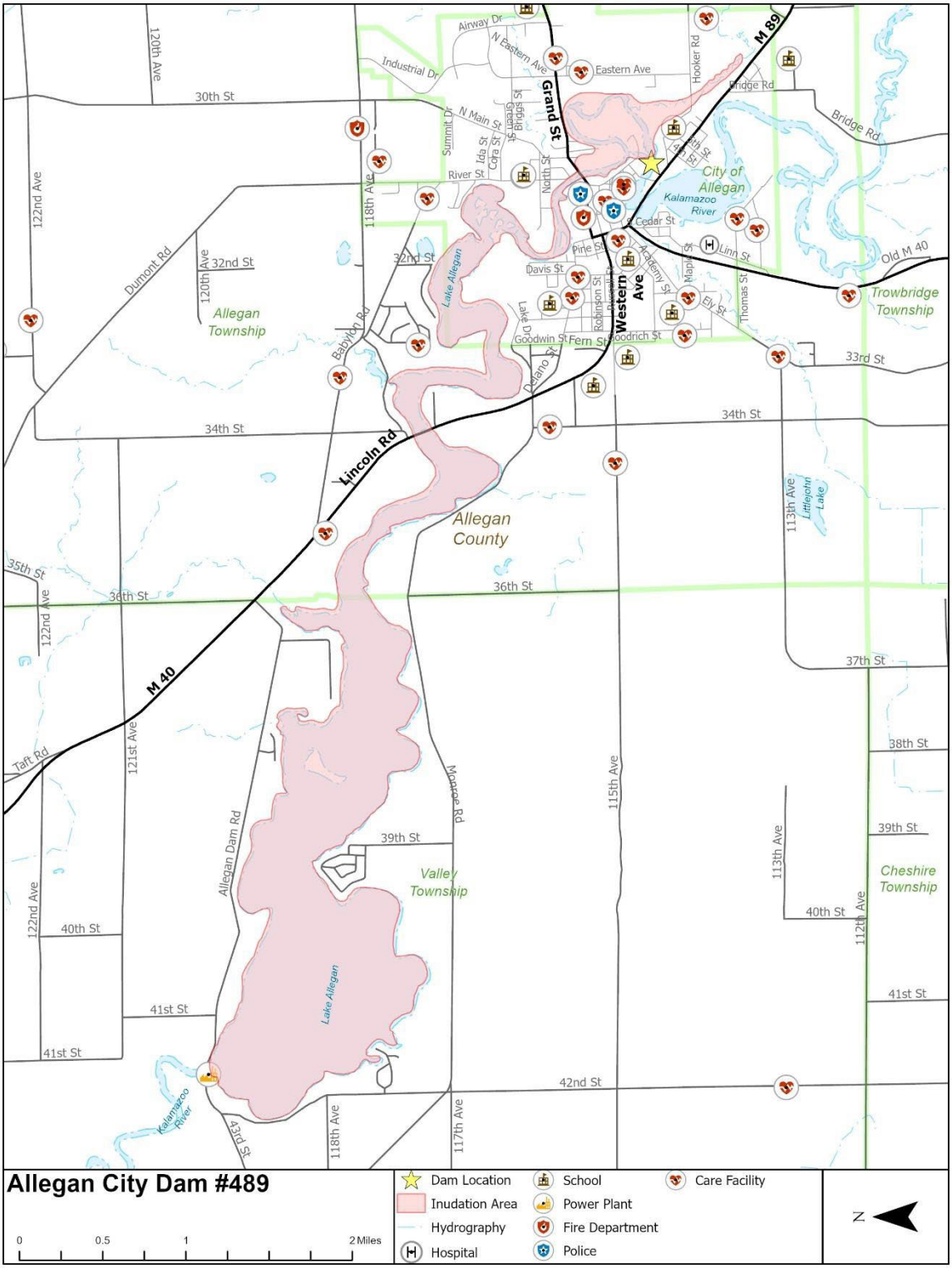




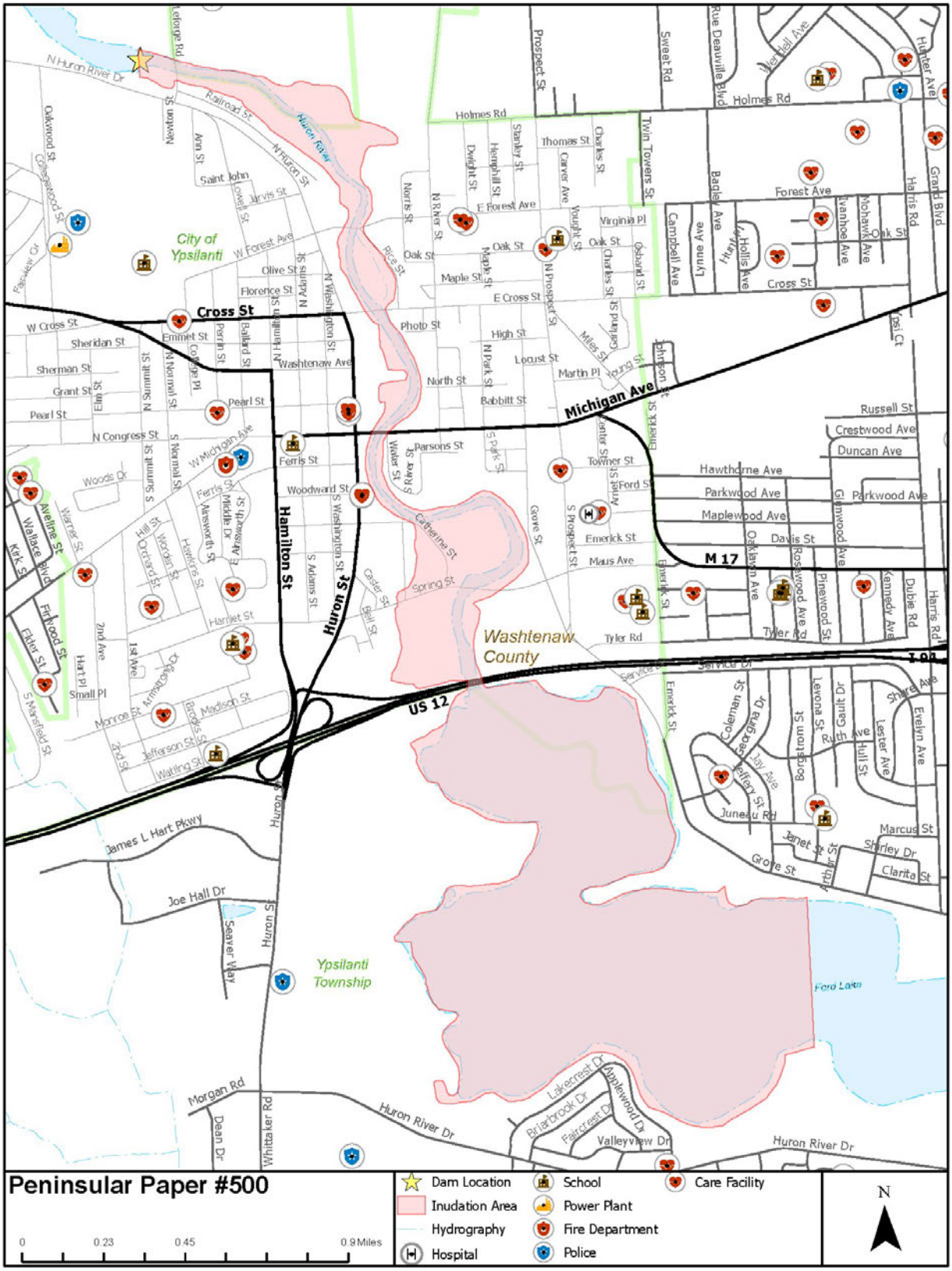
(source: EGLE DSP, July 2023)



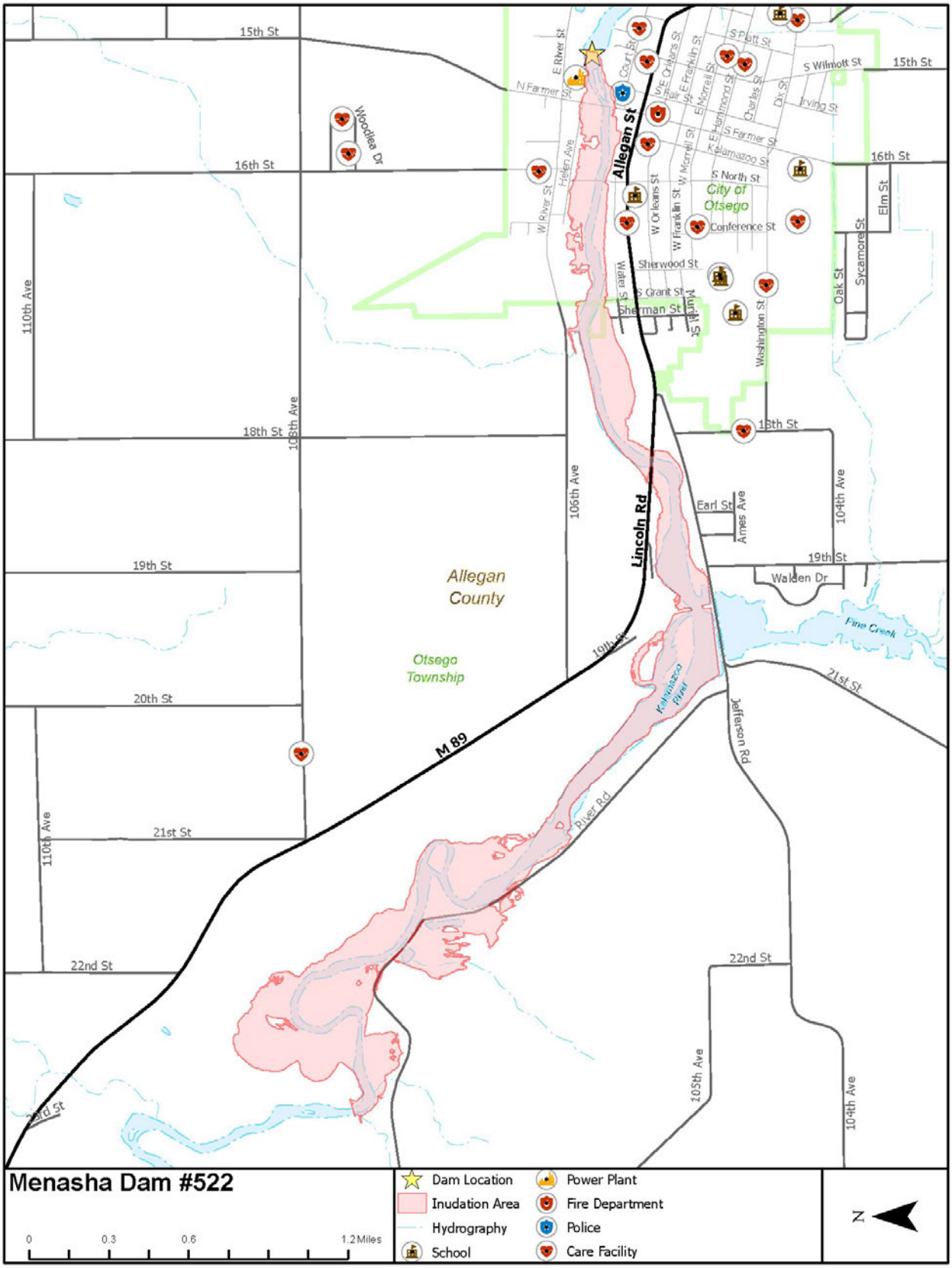
(source: EGLE DSP, July 2023)



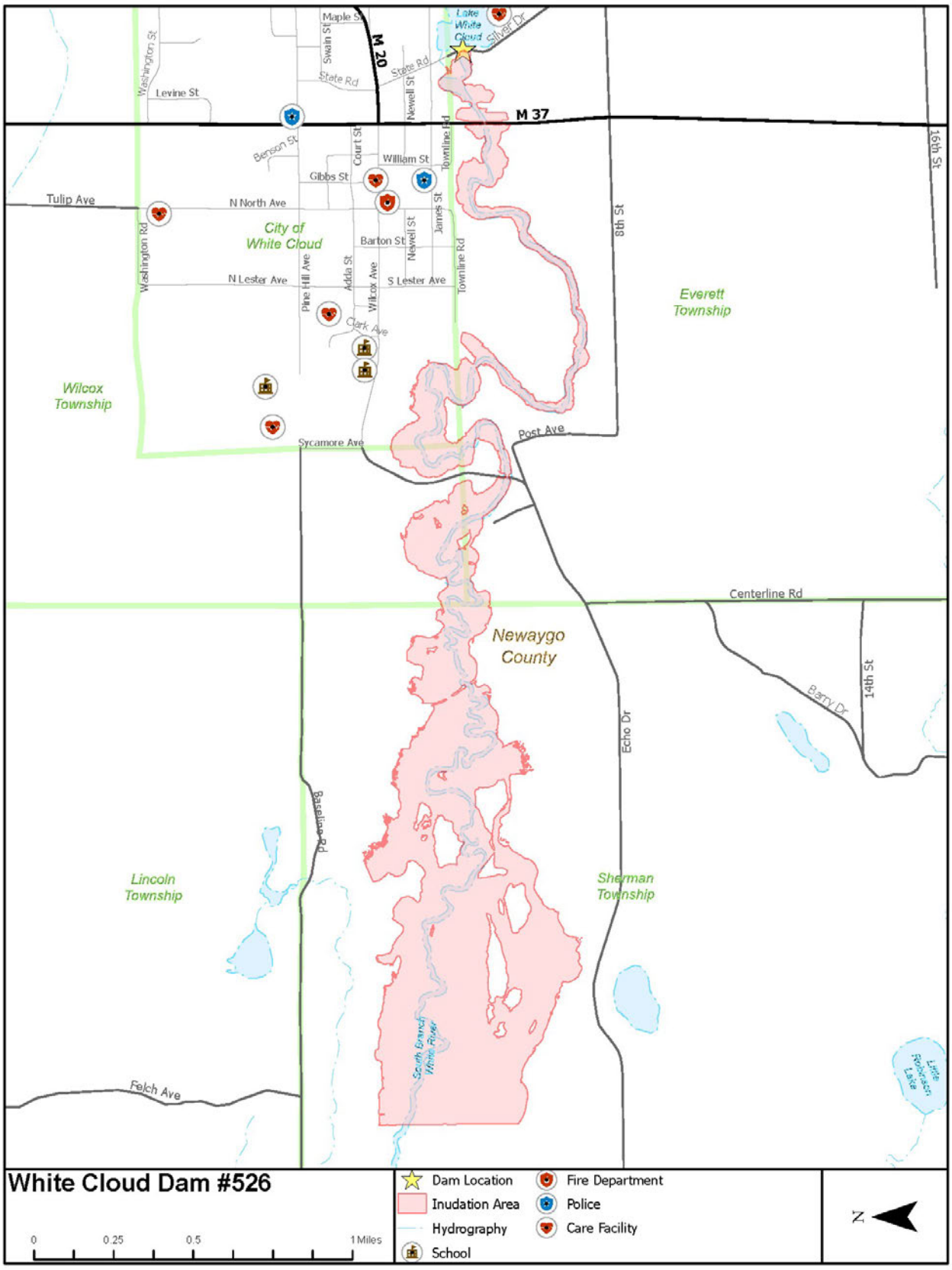
(source: EGLE DSP, January 2024)



(source: EGLE DSP, July 2023)



(source: EGLE DSP, July 2023)



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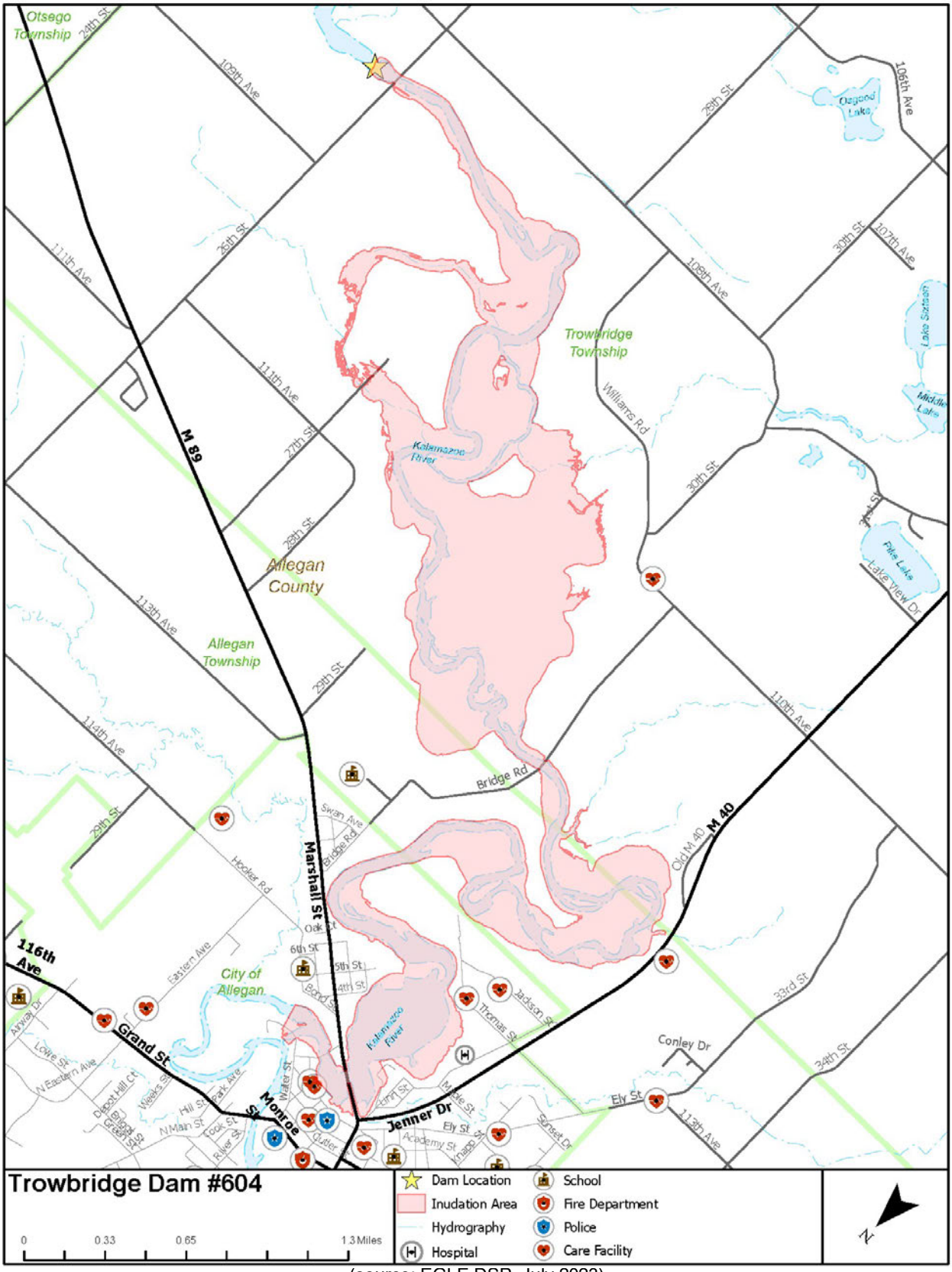
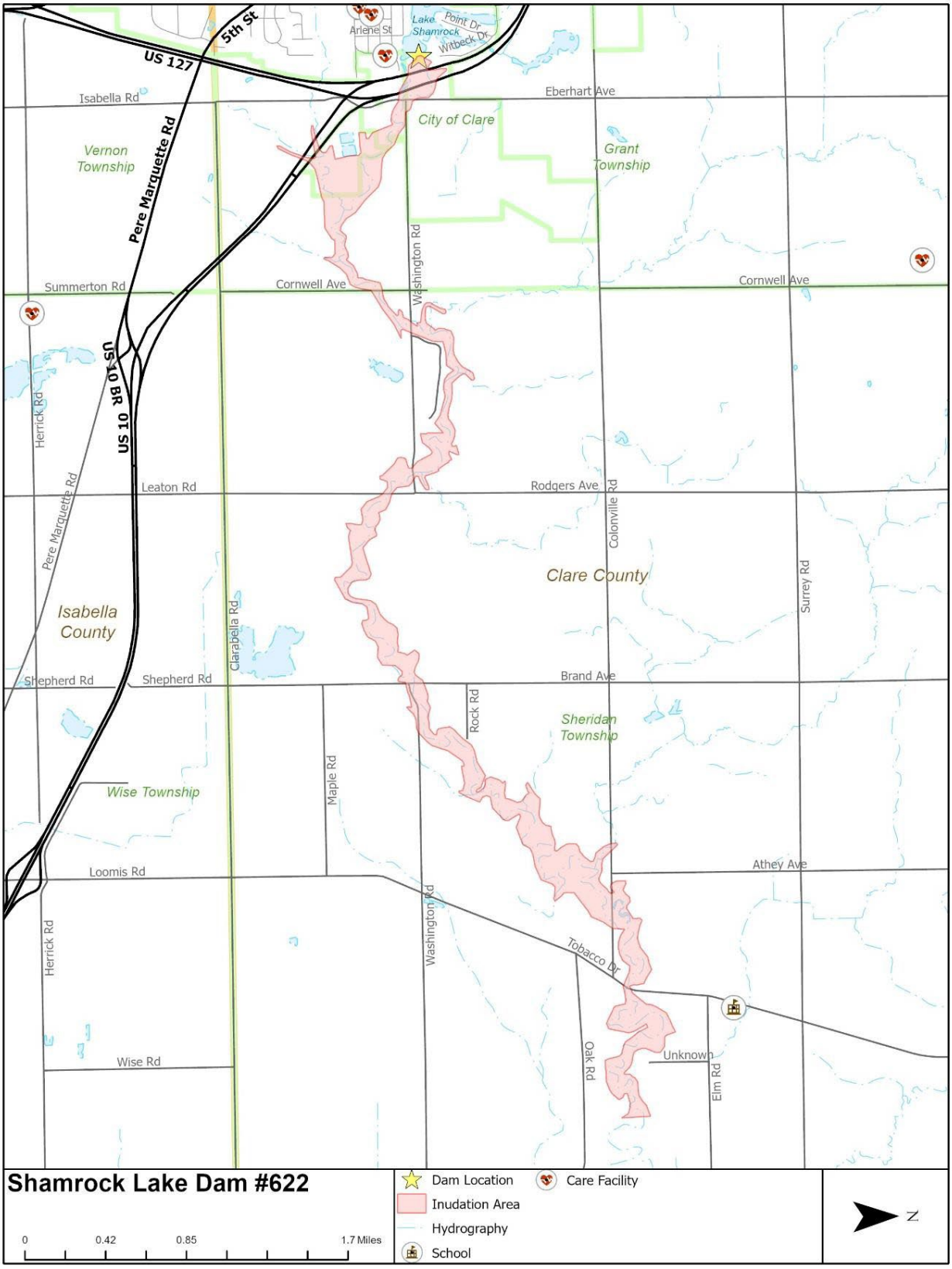


(source: EGLE DSP, July 2023)



(source: EGLE DSP, January 2024)

Appendix 9: Public Perceptions on Hazard Mitigation

General public perceptions on hazard mitigation, as a state-of-the-art term, is typically limited. While practitioners in the field of emergency management recognize FEMA defined definitions for core capabilities or phases of an emergency, the general public tends to blend such terminology together. Five mission areas as defined by FEMA include:

- Prevention
  - Prevent, avoid, or stop an imminent, threatened, or actual act of terrorism.
- Protection
  - Protect our citizens, residents, visitors, and assets against the greatest threats and hazards in a manner that allows our interests, aspirations, and way of life to thrive.
- Mitigation
  - Reduce the loss of life and property by lessening the impact of future disasters.
- Response
  - Respond quickly to save lives, protect property and the environment, and meet basic human needs in the aftermath of a catastrophic incident.
- Recovery
  - Recover through a focus on the timely restoration, strengthening and revitalization of infrastructure, housing, and a sustainable economy, as well as the health, social, cultural, historic, and environmental fabric of communities affected by a catastrophic incident.

Additional terms are often used in a similar context (e.g., preparedness, resiliency, sustainability). While the distinctions of these terms may not always be important to the general public during mitigation planning, some level of educational efforts may be warranted based on the nature and scope of the project.

Perceptions

From the standpoint as it relates to mitigation efforts led by MSP/EMHSD and FEMA, the average citizen will typically view such actions based on whether they believe government is well intentioned, competent in its job, and being a good steward of tax dollars. Some ideological factors will come into play based on the level of government that is involved (i.e., local, state, federal) and the extent a community wants any level of governmental interaction. Individual citizens also face risk differently, both in general and based on specific factors (e.g., the hazard being considered, when the hazard last resulted in an emergency, the extent a hazard has impacted them personally, who is paying for the mitigation and at what cost). One relatively newer development, not yet a significant problem for Michigan as a whole, is more hazards being deemed as uninsurable by private companies in the marketplace (e.g., California wildfires). This will likely increase demand for mitigation efforts in such areas.

A full review of the scientific literature on this topic is beyond the scope of this publication. A cursory review done for the MHMP also showed some contradictory findings. Regardless, it is important for emergency managers and local planners to understand general community sentiment before embarking on significant hazard mitigation efforts.

Impacts on Public Confidence in State Government

State hazard mitigation plans are required by EMAP to consider the impacts that hazards have on "public confidence in the jurisdiction's governance" (Emergency Management Standard 4.1.2(7), EMAP EMS 5-2022). Although confidence is not a defined term in the standard, the MHMP views it as a function of perceived competence and trust.

To the extent that mitigation efforts are handled well, all other things being equal, trust should increase. If efforts are handled poorly, or perceived to be handled poorly, it will decrease. Many of the factors previously discussed (e.g., terminology confusion, personal impacts) should be expected to greatly affect these perceptions however, especially in the aftermath of a particularly damaging incident. Important factors will also include the extent that obvious mitigation measures failed (e.g., a breached dam) or adequate warning was perceived as not being provided.

Many communities may view their overall "governmental perceptions" on only the *response* to a disaster, and may also not draw distinctions between local, state, and federal efforts. The perceived competence of non-governmental stakeholders (e.g., non-profit sheltering, television weather broadcasts) may also become part of an overarching opinion on how a disaster or emergency was handled (as opposed to specific opinion on mitigation efforts). In a similar vein, some hazards exist where government may not be viewed as directly responsible for poor outcomes but will still be judged as related to a lack of regulations over private industry. This can be further complicated based on the legal constructs of multijurisdictional regulation, or a lack thereof, and Constitutional frameworks (e.g., federal level railroad regulations).

Taking these factors and limitations into account, the following considerations have been included to highlight how hazards may impact public confidence in Michigan government. The information is considered part of an overall consequence analysis, as required by EMAP.

Natural Hazards

For the natural hazards considered in Chapter 4, the general public typically understands that no one has control over the weather. Climate change has begun to alter this viewpoint however, and to the extent that connections between greenhouse gas emissions and increased weather emergencies are linked in the public persona, natural hazard disasters may impact public confidence over whether state government has contributed to a rise in temperatures and precipitation (see Appendix 3). The effects of extreme heat may also be viewed in this manner, especially if inadequate cooling centers have been provided, although this may be viewed as more of a local level or non-profit function.

Natural hazards such as tornadoes also lend themselves to warning, such as from sirens. This is typically viewed as occurring at the local level, but inadequate warnings may also impact public confidence with the state. Many beach areas also now contain warning flags as related to rough waters and drowning.

Some level of regulatory confidence may be shaken based on hazard type (for example, water regulations with drought), although attempts at regulation may also receive pushback from the general populace. The state is generally seen as playing a major role in wildfire response and prevention. While it is beyond the scope of the MHMP to draw specific conclusions for all hazard perceptions, many might assume that the public would not hold Michigan government directly responsible for the occurrence of some natural hazards, such as an asteroid colliding with the state.

Although dam failures may be viewed as a technological hazard, they have been placed in the MHMP along with flooding because of a similarity in their impacts. Dam regulation may therefore impact public confidence in the wake of failures. The actual regulatory environment for dams is mixed. While most are overseen at the state level, some are primarily regulated by the federal government (e.g., those used for hydrological power). Most dams are privately owned, although some state ownership does exist.

Technological and Human-Related Hazards

For the technological and human-related hazards considered in Chapter 4, most areas where public sentiment would be shaken in Michigan government would be related to regulation. This would be the case for such hazards as nuclear power plant emergencies, hazardous waste incidents, etc., even if some of these areas are overseen at the federal level. Electric utilities are generally not publicly owned in Michigan, but some limited state regulation exists (the nuances of which are not always understood by the general public). Pipelines are also part of mixed regulatory environments, carrying everything from oil to natural gas to water. Confidence in state government has been affected in the past as a result of oil spills, especially impacting waterways, as well as water delivery pipes that have been tainted by lead.

Michigan contains many state roads and bridges. Although not all members of the public understand the nature of local roads and federal highways, many still do, particularly when it comes to major infrastructure like the Mackinac Bridge. Emergencies at these facilities, particularly if related to poor maintenance, would greatly impact public confidence. There is also a small but existing nexus to the MSP as it relates to overall law enforcement activities (e.g., speeding, commercial vehicles). The impacts of major structure fires would mostly be judged at the local level (e.g., fire departments, code enforcement).

Human-related hazards represent some of the most challenging risks to assess as related to public confidence in state government. Terrorism is by and large considered a federal matter, although the state does serve many important roles. Similarly, Michigan plays a role in helping to mitigate cyber hazards, although it is an area that many people may not associate with state government. Tragedies that result due to civil unrest will in particular likely be politically judged. It is possible that MSP personnel will respond to such events and could be criticized for either providing lax security or being overly aggressive depending on public perception. State government would not be blamed for any nuclear attack incident as it relates to war, but the effectiveness of evacuations and other factors could still be considered.

Confidence as it relates to public health emergencies will vary greatly based on the nature of the associated acute crisis. Perceptions as to whether the state has done too little or too much may also apply to pandemics and contamination. This again would be based more on how the state executes its regulatory role rather than the state being a direct contributor. Excessive heat impacts have been previously mentioned.

Appendix 10: Plan Maintenance

The MHMP is maintained primarily according to FEMA policy guidance, as well as to meet the requirements of EMAP. Components of the Action Plan are monitored for progress. The MSP/EMHSD is the state department tasked with the maintenance, publishing, and overarching monitoring of the plan.

Section 1: Revision Schedule

The MHMP and its components are fully revised at least once every five years according to federal regulations (see Chapter 1), with smaller interim revisions made as necessary before the next fully updated edition of the publication is due. Substantive interim revisions are included in change log appendices after contents have been revised.

Section 2: Action Plan Monitoring

The MSP/EMHSD is frequently the SAA for the federal programs that are part of the Action Plan and is also responsible for tracking its activities. This may be done by various MSP/EMHSD staff, but for purposes of MHMP maintenance is ultimately assigned to the State Planner in charge of coordinating the MHMP. Staff supervisors may also play an indirect role in overseeing the completion of certain mitigation actions.

Execution of Action Plan components is often a joint activity between the MSP/EMHSD and other state departments, agencies, or stakeholders. While some base level tracking of plan activities will out of necessity be completed by the stakeholders doing the hands-on work, the MSP/EMHSD is ultimately responsible for monitoring activities as they relate to FEMA maintenance requirements for the Action Plan. For items where the MSP/EMHSD is not the lead hands-on stakeholder, simple monitoring activities should not be inferred as ownership of other departmental initiatives. Federal regulations and FEMA required state-level assurances ultimately guide the monitoring requirements of the MHMP to ensure that state access to federal funding is not jeopardized. The Action Plan (from Chapter 7) is largely reproduced below, also including which stakeholders are lead action implementers (right column) and providing additional information for FEMA regarding the identification of likely funding sources. Funding references are primarily included in the narrative for the overall objective but may also be included with a specific implementation action item where necessary.

Action Plan Lead Implementers

Objective	Target Date	GOAL 1: Prioritize Life Safety Objective / Implementation Action	Lead Implementer
1.1		Resilient health and safety in the face of climate change, including in anticipation of an increased frequency of extreme heat.	
	2024	*a. Conduct a series of trainings for Local Health Departments (LHDs) to broadly cover how to integrate climate adaptation into their essential public health functions. Targeting three webinars for 2024 with the intent for representation from all LHDs. Primarily funded out of the MDHHS general budget (legislative appropriation) and the Centers for Disease Control and Prevention (CDC) Public Health Infrastructure Development Grant (PHIDG).*	MDHHS
	2028	*b. Leverage the Michigan Climate and Health Adaptation Planning (MICHAP) Guide by having state government partner with the local governmental members of Michigan Green Communities. The collaboration will include training (three webinars and two in person workshops) that will lead to facilitated mitigation measures for at least two communities over the next four years. The MICHAP program manager position is funded by a CDC PHIDG. Some components are funded by the Environmental Protection Agency (EPA) via the Great Lakes Restoration Initiative.*	MDHHS & EGLE (Catalyst Communities)
	2025	*c. Finalize/garner funding to create resilience hub(s), initially to be established in eastern Detroit. Attempt to roll out to other communities as funding allows. This will be done in conjunction with an initiative to better understand the risk factors for heat and cold illness, evaluate the syndromic surveillance system for heat and cold, and develop strategies for improved planning and use of*	MDHHS

Objective	Target Date	GOAL 1: Prioritize Life Safety Objective / Implementation Action	Lead Implementer
		shelters/resilience hubs. Potential funding sources include the EPA via the Inflation Reduction Act Community Change Grants Program or Environmental Justice Government to Government Program.	
	2024	*d. Expand state administered and collaborative urban forestry opportunities to accelerate urban tree/wood lifecycle stewardship and associated mitigation benefits. After expansion, target of at least four community engagement events annually, designed to spur initiatives related to climate adaptation and urban wood utilization. The federal Climate and Economic Justice Screening Tool will be used to ensure vulnerable communities are included. Funding is by the Department of Natural Resources (DNR) via the US Department of Agriculture (USDA) Forest Service.*	DNR
1.2		Promote and develop public alert and early warning capabilities as part of integrated safety systems (including safe room facilities).	
	2024	*a. Achieve statewide coverage for the Integrated Public Alert and Warning System (IPAWS) in all counties. Staff overseeing this effort are paid for out of an Emergency Management Performance Grant (EMPG).*	MSP/EMHSD (Operations Management)
	2025	*b. Pursue pilot project for "Giant Voice"/multihazard alert systems on state park or similar properties, with or without accompanying "safe room" shelters. A variety of FEMA Hazard Mitigation Assistance (HMA) funding, such as via Building Resilient Infrastructure and Communities (BRIC), are potential options to explore (using BRIC would require a safe room component). Funds from the DNR could potentially be used (legislative appropriation).*	DNR & MSP/EMHSD
1.3		Mitigate the risk and consequences of dam failure through the assessment, review, and updating of high hazard potential dams (HHPD) and associated maps, plans, and programs. EGLE Dam Safety Program (DSP) staff are paid for out of a combination of the FEMA Dam Risk Reduction Grant Fund, DNR funds (legislative appropriation), and EGLE's Water Resource Division general fund (legislative appropriation)	
	2026	*a. The EGLE DSP will ensure an Emergency Action Plans (EAP) for all HHPD have been reviewed and updated at least every three years (and made part of such an ongoing EAP review cycle).*	EGLE DSP
	2025	*b. The DSP will work towards creating inundation maps for all HHPD in the state, with the intention of making inundation boundaries available to the public for use in local planning and educational efforts.*	EGLE DSP
	ONG	*c. The DSP will collaborate with EMHSD in identifying dams eligible under the HHPD Grant Program so that applicable jurisdictions can be encouraged to make local mitigation plans HHPD Grant Program compliant.*	EGLE DSP & MSP/ EMHSD (Local Planner)
1.4		Provide the owners and operators of Critical Infrastructure/Key Resources (CIKR) with data so that they and other stakeholders can take appropriate mitigative measures. Critical Information Specialist staff who work within the MIOC are funded by the Homeland Security Grant Program (HSGP). Staff for the Michigan Public Service Commission (MPSC) are funded out of the budget for Licensing and Regulatory Affairs (LARA) via legislative appropriation.	
	ONG	*a. Provide Physical Security Assessments to CIKR owners and operators, with a target of completing 12-18 assessments annually through the Michigan Intelligence Operations Center (MIOC) and other partners.*	MIOC
	2025	*b. Track electric power grid reliability by having utilities report granular data to the MPSC, with the intent of mapping such data and placing it on a public facing website so that utilities, emergency managers, and planners can better identify historically problematic areas and take appropriate mitigation measures to reduce future outages.*	MPSC
	2025	*c. Continue to identify and define CIKR across the state in order to analyze interdependencies that can create worst case event scenarios, using the information to increase the resiliency of such assets. Three reports will be created as part of the Michigan Infrastructure Prioritization Project.*	MIOC

Objective	Target Date	GOAL 2: Reduce Property Damage Objective / Implementation Action	Lead Implementer
2.1		Acquire/remove, relocate, or elevate structures that currently occupy floodplains or that have otherwise suffered from repetitive flood losses.	
	ONG	*a. Identify structures that have suffered from repetitive flood loss. Applicable staff are funded through EMPG.*	MSP/EMHSD (SHMO)
	ONG	*b. Assist in the acquiring/removing, relocation, or elevation of at-risk structures where feasible. Possible funding via FEMA HMA, including BRIC.*	MSP/EMHSD (SHMO)
2.2		Position the state to take proactive climate related mitigation measures prior to facing significant property loss.	
	2025	*a. Fully integrate Michigan into the Drought Early Warning System (DEWS), part of the National Integrated Drought Information System (NIDIS), by becoming an official contributor to the Midwest Network and participant in the Midwest DEWS Strategic Action Plan (2025). Funding for staff lead via EMPG.*	Multi-Agency (MSP/EMHSD State Planner lead)
	2024	*b. Finalize criteria for use of an invasive species Immediate Response Fund, to begin availability in 2024 to address a founding population, newly discovered watch list population, or high threat invasive species. Funding made available via the DNR budget (legislative appropriation).*	DNR (lead), EGLE, & MDARD
	2024	*c. Adopt a Tribal-State Manoomin/Mnomen Stewardship Plan as a continuation of the Michigan Wild Rice Initiative to ensure measures are taken to mitigate against the potential impacts of climate change on culturally important species. Funding via Office of the Great Lakes, Michigan Great Lakes Protection Fund.*	EGLE
2.3		Assist local communities and fire departments with education efforts, wildfire planning, and mitigation projects statewide.	
	ONG	*a. Assist and make use of grants from the USDA Forest Service to help fund communities developing Community Wildfire Protection Plans (CWPP), and mitigation projects in those plans, as funding allows.*	DNR
	ONG	*b. Encourage communities with completed plans to seek hazard mitigation grant funding through annual Wildfire Risk Reduction (WRR) Grants to address projects identified in their CWPP as appropriate*	DNR
	ONG	*c. Work with identified communities/residents to provide technical assistance in plan development, and to focus local activities to address their wildfire risks/vulnerabilities (where local willingness exists to take on such tasks) to educate on and promote the fire-related elements of their CWPPs, Firewise concepts, "fire adapted community" standards, etc. Funding as above.*	DNR
2.4		Ensure building requirements are consistent with minimum National Flood Insurance Program (NFIP) standards. Primary funding for staff lead is provided a FEMA Community Assistance Program, State Support Services Element grant.	
	2024	*a. Collaborate with stakeholders to develop a pathway to bring Michigan into full compliance where state and local floodplain regulations do not meet minimum NFIP requirements as listed in 44CFR60.3.*	EGLE
2.5		Implement agricultural and environmental assurance programs to reduce onsite environmental risks and to mitigate against potential runoff. These programs are funded out of the MDARD budget (legislative appropriation).	
	ONG	*a. Conduct 1500 risk assessments (annually) across various Michigan Department of Agriculture and Rural Development (MDARD) programs, including but not limited to the Bulk Storage Program and Michigan Agricultural Environmental Assurance Program.*	MDARD
2.6		Collaborate with the United States Army Corp. of Engineers (USACE) on a southeast Michigan Pluvial Flood Study, done in conjunction with the Great Lakes Water Authority (GLWA).	
	2027	*a. If approved, leverage a USACE study to be funded by the Water Resources Development Act to aid in identifying why current efforts to sufficiently mitigate pluvial flooding in southeast Michigan are not fully working and to evaluate alternatives to address the problem. The study could start in 2024 and is estimated to take up to three years to complete.*	MSP/EMHSD (SHMO & State Planner), USACE

Objective	Target Date	GOAL 3: Collaborate With and Increase Stakeholder Knowledge Objective / Implementation Action	Lead Implementer
3.1		Collaborate with and increase the knowledge of emergency managers, urban/regional planning organizations, and other relevant stakeholders about hazard mitigation planning principles, projects, and opportunities. Funded via EMPG.	
	ONG	*a. Provide training and guidance about hazard mitigation processes, plan review standards, and project ideas.*	MSP/EMHSD (Local Planner)
	ONG	*b. Encourage land-management and development practices that help reduce long-term hazard risks and vulnerabilities, and the integration of local hazard mitigation plans with other local/regional planning processes and regulations.*	MSP/EMHSD (Local Planner)
	ONG	*c. Educate and collaborate with state and federal legislators to advance mitigation related goals and objectives.*	MSP/EMHSD (SHMO)
3.2		Utilize a FEMA Integration Team (FIT) position to partner with EMHSD to increase the knowledge of emergency managers, urban/regional planners, and the general public in accordance with objective 3.1. Funding is provided by the FEMA Disaster Relief Fund.	
	2024	*a. Upon anticipated hiring in 2024, assist the department with 3.1(a) and 3.1(b), as well as by conducting other related initiatives as jointly determined by FEMA and MSP/EMHSD management after successful onboarding.*	FEMA FIT
3.3		Promote community resilience by advancing mitigation education and resource partnerships. Staff are paid for out of EMPG and HSGP grant dollars.	
	ONG	*a. Support whole community outreach programs such as the Prepare Fair, hosting a minimum of three such public outreach programs each year.*	MSP/EMHSD (Preparedness)
	ONG	*b. Hold or help to conduct a Great Lakes Homeland Security Training Conference each year, to include resiliency related content.*	MSP/EMHSD (Preparedness)
	ONG	*c. Add 10 new private sector partners to the Public Private Sector Partnership (P3) program each year.*	MSP/EMHSD (P3)
	ONG	*d. Add 10 new private sector partners to the P3 resource list each year.*	MSP/EMHSD (P3)

Objective	Target Date	GOAL 4: Execute Mitigation Related Programs and Administrative Duties Objective / Implementation Action	Lead Implementer
4.1		Maintain and strengthen partnerships with state agencies and other stakeholders as appropriate as it relates to collaboration with the Michigan Hazard Mitigation Plan (MHMP). Funded via EMPG.	
	ONG	*a. Coordinate with other state agencies involved in resiliency activities, especially as it relates to hazard assessment and mitigation related objectives/actions.*	MSP/EMHSD (State Planner)
	ONG	*b. Participate with standing collaborative groups, including but not limited to the Silver Jackets, Michigan Climate Coalition, and Michigan Emergency Management and Chemical Security Coordination meetings.*	MSP/EMHSD (State Planner)
	ONG	*c. Attend public Michigan Citizen-Community Emergency Response Coordinating Council (MCCERCC) general meetings, as well as MCCERCC Mitigation Committee meetings, to the fullest extent possible.*	MSP/EMHSD (State Planner)
4.2		Continually revise and enhance the MHMP to ensure it remains current, effective, and in compliance with the federal Disaster Mitigation Act of 2000 and the Emergency Management Accreditation Program (EMAP). Funded via EMPG.	
	ONG	*a. Integrate data and findings from interim Michigan Hazard Analysis (MHA) updates and newly approved local hazard mitigation plans, with change log usage to describe updated content.*	MSP/EMHSD (State Planner)

Objective	Target Date	GOAL 4: Execute Mitigation Related Programs and Administrative Duties Objective / Implementation Action	Lead Implementer
	ONG	*b. Conduct at least two "partial" updates to MHMP publications in between their five-year planning cycles (or more as necessary) as a result of changing risks or new regulations.*	MSP/EMHSD (State Planner)
4.3		Encourage participation in mitigation grant programs throughout the state. Staff is funded via EMPG to garner participation in programs, including via HMA.	
	ONG	*a. Expand the sharing of successful applications that result in mitigation grant funding by annually posting FEMA grant selections on the MSP/EMHSD website.*	MSP/EMHSD (SHMO)
	2024	*b. Create a Compendium of Project Summaries for successfully completed mitigation projects, as a standalone publication by Dec 2024.*	MSP/EMHSD (SHMO)
	ONG	*c. Present at a minimum of two conferences per year to Michigan associations and councils of governments as part of elected official related mitigation education.*	MSP/EMHSD (SHMO)
	ONG	*d. Conduct at least ten webinars per year targeting local emergency managers at the county, city, university, and tribal levels.*	MSP/EMHSD (SLSS)
	ONG	*e. Encourage local jurisdiction participation in FEMA Region 5 application development webinars before BRIC program application periods.*	MSP/EMHSD (SHMO)
4.4		Strengthen local hazard mitigation planning throughout the state. Funded via EMPG.	
	ONG	*a. Promote and support the development, update, and timely approval of local hazard mitigation plans (including specialized plans, hazard mitigation projects, and activities).*	MSP/EMHSD (Local Planner)
	ONG	*b. Monitor and track local plans to identify hazards that are becoming more frequent, damaging, or otherwise important in order to inform state level planning.*	MSP/EMHSD (Local Planner)
	2024	*c. Revise and promote MSP/EMHSD Publication 207 (Local Hazard Mitigation Planning Handbook) by the end of 2024.*	MSP/EMHSD (Local Planner)
4.5		Participate in new FEMA grants, loan programs, and initiatives as introduced.	
	2024	*a. Assist in establishing, implementing, and then fine tuning a new revolving loan fund in the state via the Safeguarding Tomorrow Revolving Loan Fund (STRLF).*	MSP/EMHSD (SHMO)
	2024	*b. Leverage Michigan's Community Disaster Resilience Zone (CDRZ) designations for successful mitigation projects in areas that have been targeted by the Climate and Economic Justice Screening Tool.*	MSP/EMHSD (SHMO)
4.6		Work to establish a new, state-funded (legislative appropriation) hazard mitigation grant program, administered by MSP/EMHSD. Staff efforts funded via EMPG.	
	ONG	*a. Maintain a relationship with the MSP legislative liaison to be kept apprised of introduced mitigation related state legislation or administrative rules.*	MSP/EMHSD (State Planner)
	ONG	*b. Promote an MSP/EMHSD administered state-level hazard mitigation funding program to become a legislative priority.*	MSP/EMHSD (Leadership)
	ONG	*c. If approved, use the grant program to fund projects prioritized by MSP/EMHSD that FEMA does not provide funding for, or are worthy projects otherwise struggling to meet local matching fund requirements.*	MSP/EMHSD (SHMO)

Applicable MSP/EMHSD staff will coordinate with the lead implementer at least twice annually to determine progress. Where progress is not being met the activities will be scrutinized to determine what needs to be accomplished in order to obtain success. Such adjustments may result in additional meetings, methods, staff, or stakeholders becoming part of efforts, as applicable to the action item's challenges and obstacles. While the majority of the objectives in the Action Plan are meant to be obtainable, some items were also purposefully chosen that may be difficult to fully accomplish (i.e., a "stretch goal"). Specifically, objective 4.6 has not been accomplished in the past despite it being an objective in the 2019 MHMP Action Plan. This objective faces several hurdles from both a budgetary and legislative standpoint, which MSP/EMHSD leadership is working to overcome.

Section 3: Past Mitigation Plan Objectives

Reviewing the 2019 MHMP Action Plan was a necessary step before a 2024 MHMP Action Plan could be finalized. Some obstacles presented themselves that were unique to the 2024 MHMP planning process (see Appendix 1). Challenges included high employee turnover at the state level, a newly hired staff member with no previous history with the plan, the COVID-19 pandemic which interrupted established processes, and the issuance of new FEMA policy guidance during the planning period. These obstacles were viewed as an opportunity to overhaul the Action Plan more completely, with several previous items being consolidated or removed as climate change and other factors rose as higher priorities during the 2024 planning process.

Wording for some objectives was reworked as necessary for clarity in regard to intent or the assignment of a lead implementing stakeholder. Language was also updated to reflect changes to departmental names, newer technology, and program modifications.

2024 Objectives

Objectives in the 2024 MHMP can be categorized as (1) successful objectives carried over from the 2019 MHMP so they can be repeated, (2) unsuccessful objectives carried over to be reattempted, and (3) those entirely new to the plan.

(1) The following 2024 MHMP objectives were largely carried over from the 2019 MHMP after being completed during that plan's time period. Because of their ongoing importance they have been retained in the 2024 MHMP.

- Objectives: 2.1(a), 2.1(b), 2.3(a), 2.3(b), 2.3(c), 3.1(a), 3.1(b), 3.1(c), 4.1(a), 4.1(b), 4.1(c), 4.2(a), 4.3(c), 4.4(a), 4.6(b)

Activities and accomplishments related to these objectives since the MHMP was approved in 2019 include:
For 2.1(a)(b), the SHMO routinely accessed FEMA flood databases as an aid in promoting associated HMA grant opportunities, leading to the approval of 11 HMA grants for the acquisition of 142 floodplain properties, with 39 such properties at risk having been acquired. Locations where grants have been approved include in the municipalities of Sanford, Allen Park, Ann Arbor, Dearborn Heights, Lansing, and Midland, as well as in Plainfield Township and Clare and Macomb Counties.

For 2.3(a)(b)(c), the DNR continued to assist local communities with wildfire education and mitigation efforts where feasible based on available federal funding. Many ongoing activities can be referenced on their webpage, as well as in the Wildfires chapter of the MHA. As examples, the DNR assisted Gogebic County with writing a new CWPP in 2023, and existing plans were updated for Crawford, Oceana, and Lake Counties. A Community Wildfire Defense Grant coordinator position has also been recently filled.

For 3.1(a)(b)(c), the Local Planner collaborated with associated stakeholders as detailed in Appendix 7. Two specific presentations were also given as they related to land-management and development practices, which are integrated concepts in approved local hazard mitigation plans. Other examples included a webinar presentation to municipal managers in 2020 and to urban planning students at the University of Michigan in 2021. The SHMO engaged in educational activities with legislators during this time period, with examples including a State Senator, a State Representative at two separate meetings, and a US Senator at eight separate meetings as part of collaboration efforts.

For 4.1(a)(b)(c), the State Planner coordinated with other state agencies over 100 times, and the MCCERCC over 10 times, as substantially detailed in Appendix 1. Meetings were also attended for groups such as the Silver Jackets and the Michigan Climate Coalition (four and three meetings in 2023, respectively).

For 4.2(a), the 2020 MHA represented a new full update for technological and human-related hazards, which also received a subsequent interim update in January 2023. Local hazard related discussions were also a part of and incorporated into new local Emergency Operation Plan templates in 2022. These changes were part of the data considerations used in the creation of the 2024 MHMP.

For 4.3(c), the SHMO provided regular presentations at MCCERCC meetings and Michigan Specific Core Emergency Management Knowledge Requirement training courses. Other examples include presentations before the Michigan Stormwater and Floodplain Association, Eastern Michigan Council of Governments, Great Lakes Water Authority, Michigan Townships Association, and an EGLE local official floodplain management webinar.

For 4.4(a), the Local Planner supported the approval of local hazard mitigation plans, with details on success and status included in Chapter 6. The plans were routinely provided to FEMA in order for the approval process to be completed.

For 4.6(b), the State Planner monitored the progress of mitigation related legislative activities by meeting with applicable parties, including the MSP legislative liaison (two touchpoints in 2023).

(2) The following 2024 MHMP objective was largely carried over from the 2019 MHMP but was not completed during that plan's time period. The objective required legislation that was ultimately not passed, but the objective continues to have importance and has been retained and expanded upon in the 2024 MHMP.

- Objective: 4.6(b)

(3) The following 2024 MHMP objectives are substantially new to the plan.

- Objectives: 1.1(a), 1.1(b), 1.1(c), 1.1(d), 1.2(a), 1.2(b), 1.3(a), 1.3(b), 1.3(c), 1.4(a), 1.4(b), 1.4(c), 2.2(a), 2.2(b), 2.2(c), 2.4(a), 2.5(a), 2.6(a), 3.2(a), 3.3(a), 3.3(b), 3.3(c), 3.3(d), 4.2(b), 4.3(a), 4.3(b), 4.3(d), 4.3(e), 4.4(b), 4.4(c), 4.5(a), 4.5(b), 4.6(a), 4.6(c)

2019 Objectives

The following objectives from the 2019 MHMP are not substantially included in the 2024 MHMP. Note that the objectives referred to below uses nomenclature from the 2019 MHMP, which does *not* align with the numbering system of the current 2024 MHMP Action Plan:

- Objective 1.5 (2019): Support and utilize a system of real-time rainfall and river flow gauges throughout Michigan as part of an overall flood warning system.
- Objective 2.2 (2019): Additional evaluation of flood vulnerabilities in specified state owned or operated critical facilities.
- Objective 2.3 (2019): Consolidate flood-related data into appropriate GIS materials to promote integrated assessments that inform development decision making and future land use planning.

For objective 1.5, the State Planner attempted to discuss the objective with the USGS as specifically referenced in the objective. When delays presented themselves as related to finding the appropriate past USGS staff member to meet with, the State Planner alternatively met with the NWS SEMC and the State Climatologist to gain subject matter expertise on the general needs of such a system. While all systems can be improved, the conclusion from both meetings was that Michigan has an above average rainfall and river gauge system, and that the USGS WaterWatch website (and other tools) were being updated and sufficient. The USGS was again contacted in order to obtain updated gage locations that were additionally included as a physical map in the MHA. The 2019 objective was then considered closed.

For objective 2.2, the State Planner made inquiry into the original genesis for the objective. This resulted in a determination that it primarily related to specific buildings used by the state in Wayne County that frequently flooded. These concerns had been largely ameliorated by downsizing, no longer using certain parts of facilities, or making other accommodations. The vulnerability to the specific buildings was no longer considered a high priority by DTMB, who had been the lead implementer for the objective. Also taking into account that a broader pluvial flooding related objective was going to be placed in the 2024 MHMP, the 2019 objective was then considered closed.

For objective 2.3, the State Planner attempted to contact the various agencies that had been involved with the lidar projects that had been at the heart of this objective. These were spread across different agencies, but enough contacts were made to determine that the lidar initiatives had been completed despite the limitations of work being done during the COVID-19 pandemic. While general RiskMAP activities still continue in the state (see Appendix 5), it was determined that their ongoing efforts did not need to be included as a specific Action Plan item in the 2024 MHMP. The 2019 objective was then considered closed.